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HUMUS

To anyone who has had long experience of the agriculture of the tropics, few things perhaps have been more striking than the great want of humus in the soil. There is a fair amount in forest soil, or in other land undisturbed from its natural conditions, but so little is there in any ordinary exposed soil that the difference in appearance that it presents when compared, for example, with an ordinary English soil can hardly fail to strike even the casual observer.

There are probably several causes for this poverty in humus, but two at least are obvious enough, and efficient in their operation —the effects of the hot sun and the leaching due to the heavy rainfall, about which we have already spoken in dealing with the question of soil erosion.

It is this poverty in humus of ground that has been left exposed for some time that lies at the root of several practices in agriculture that in the long run are decidedly harmful. In a large part of the world—in fact, in a great proportion of places where the climate will allow of the growth of forest, and the population is sufficiently sparse to allow a large enough area of land to one individual—people still practise, where they are not definitely prevented, the world-old system which in Ceylon is called chena, in India jhuming. They take a piece of forest or scrub (the former usually preferred), fell and burn all the trees of manageable size together with the undergrowth, and grow crops of grain, etc., on the ground thus exposed. The soil still contains the humus that was present in the forest, and is further enriched by the wood ashes, while at the same time it contains few seeds of weeds that are capable of growing upon open ground, so that a great deal of the usual cultivation labour becomes unnecessary. It is thus, except for the presence of stumps or of unfelled trees, in prime condition for the production of good crops, and the first and second are usually excellent. After the second crop, what with the intrusion of weeds, the regrowth of the forest plants from the roots left in the ground, the impoverishment of the soil by the growing of crops without any manure, and by the action of the sun and the rain, the crop rapidly diminishes, and in the usual practice it is found more profitable to grow only one or at the most two crops, and then to make a fresh chena. The old one is left to grow up in scrub, and in from ten to fifty years the land may once more be used in the same way.

Though carried out with more efficiency, and with greater supply both of capital and of labour, the methods of the European planter in a great part of the tropics have produced results which may in many ways be likened to those of the chena-clearer. Felling all the forest, and usually burning off the trees together with the undergrowth, he has started, like the native with his chena, upon land rich in humus and further enriched with the wood ash, and until the last twenty or thirty years he has simply exploited that land. and exhausted its natural capital, putting nothing back. The same story must be told of the earlier farmers—and, indeed, of many of those of the present day—in the United States or in the British colonies.

To treat the soil like this is simply to live upon capital, and sooner or later, the time varying with the natural richness of the ground, that capital is exhausted, and the cropping capacity of the soil is reduced to its minimum, as may be seen in a great part of India, for example, or in the vast areas of abandoned land that mark the "progress" of European agriculture in so many countries. The whole system represents a wasteful way of living, but one so natural and so obvious that there is no reason to wonder at its wide diffusion.

If land is treated like this, and no attempt made to put back something at least of what is taken out of it, it is clear that its productive capacity must fall to the minimum, for it cannot itself, by nitrification or otherwise, improve its food supply (especially the humus) at other than a very low rate. Its productive capacity will depend to a very large extent indeed upon the rainfall, as we have seen, for example, in Mr. Youngman's paper (*E.C.G.R.*, Vol. VI., 1929, p. 43), the rainfall being the one item of the food supply that varies seriously.

In such countries as much of India, what with the absence of local forest, the density of the population, the comparative absence of waste land, and the use of cowdung—the only really common manure available—as fuel, one of the very greatest problems that confront the agricultural worker is how to provide the necessary manure to bring back to the soil the necessary food materials to increase its output, remembering always that a great feature in the problem is the extreme poverty of the actual agriculturists, who cannot afford to import manure from a distance.

Even in the poorest parts of India there is a great deal of agricultural refuse of all kinds. But simply to bury this in the soil is of little real value, for owing to climatic and other difficulties, it is usually nearly impossible to reduce it to the best possible conditions of division, of carbon-nitrogen ratio, etc., even with the loss of much of its valuable contents of nitrogen. The coming of adco has rendered refuse of greater value in temperate countries, but in the tropics it has not been found to work so satisfactorily, and its cost and other things are against its use by the ordinary small cultivator. It is thus a matter for congratulation that Dr. Howard (whose recent book on this subject, written in collaboration with Mr. Y. D. Wad, is reviewed on p. 77), has devised a method by which organic refuse of all kinds may easily be reduced to a proper state to form a good humus manure, by means of the proper admixture of urine-earth, and about a third of the natural supply of cowdung (thus leaving the greater part still available as fuel). By suitable mixing of different kinds of refuse, the loss of nitrogen is prevented. While there is yet much to be done in fully elaborating this method, it is clear that it may well prove to be of the very greatest value, not only in the agriculture of tropical countries but also in the improvement of their sanitation.

THE RUSSIAN EXPERIMENTS IN PLANT BREEDING

BY

DR. C. C. HURST.

DURING the last few years the world of agricultural science has been considerably impressed by the remarkable output of papers by the Russian plant breeders and geneticists. More than a hundred papers containing reports of experiments in plant breeding have come into the writer's hands within the last two years, in which the work of about eighty Russian geneticists has been reported. Compared with the output of other nations during the same period, the Russian contributions easily outstrip the others in number. That this is not so much due to individual initiative in research on the part of the Russian scientific workers themselves is clear from the internal evidence, but on the contrary, one finds evidence of close co-operative team-work and definite organization behind it all. Apparently Russian plant breeding is nationally organized, and that seems to be one of the secrets of its success.

The success of national plant breeding, however, demands a national leader, a man of wide and yet concentrated outlook, and above all one who is in the closest possible touch with the modern rapidly advancing science of genetics, and equally *en rapport* with the ancient practical art of agriculture. A leader of this calibre is difficult to find at any time and in any country, but, fortunately, such a man has arisen in the person of Dr. N. I. Vavilov, the able Director of the Institute of Plant Industry of Leningrad.

During the last ten years Dr. Vavilov has been engaged in the national organization of plant breeding in Russia, and the success of the Russian work has so far been due to his wide grasp of the present situation and to his clear ideas of what is required in the future in a national scheme of plant breeding which is definitely planned to secure rapid and yet permanent progress in scientific agriculture. With true insight, Dr. Vavilov has based his organization for national plant breeding on pure science, and before one can understand the nature of the Russian work it is necessary to examine and follow carefully the important preliminary steps that have been taken, without which the whole plan would have degenerated into a series of isolated and haphazard cultural trials, which are far too common in agriculture and horticulture in all countries, and which lead in no definite direction.

Owing to the geographical situation of Russia and its vast extent in Europe and Asia, the problems of Russian agriculture are naturally many and various. Almost every variety of climate is encountered, from arctic to sub-tropical, and consequently Russian crops differ considerably in kind, covering almost the whole gamut of cultivated crops from wheat, maize, and fruit, to cotton, tea, and rubber. Altogether in these cultivations at least one hundred distinct species and fifty genera of plants are involved.

The fundamental basis of Russian plant breeding is the Linnean species, with its multitudinous varieties made up of different varietal complexes of Mendelian genes. Vavilov rightly concludes that the true unit of investigation in plant breeding, as in evolution, is the Linnean species, which he regards as a concrete systematic entity (Vavilov, 1930 c; Hurst, 1925 and 1927). Vavilov's geographical and systematic researches clearly demonstrate this basic principle of the species concept, and there is no doubt that the modern view of the species as a genetical complex or genomic species will ultimately supersede the loose ideas recently prevalent. In passing, it may be added that the adoption of the Linnean species as a unit does not necessarily bind us to a rigid view of species; as a matter of fact recent genetical researches on *Rosa* (Hurst, 1928) and other genera (Babcock, 1930) show that the true genetical species or genomic unit is often somewhat larger than the ordinary Linnean species, approximating in some cases to the generic section of the taxonomist. The point is that the species is a definite genetical entity capable of experimental demonstration, and that the plan of Russian plant breeding is wisely based on this conception. Consequently each species has been investigated separately and intensively, and the whole of its varieties and forms analyzed and tabulated statistically in order to ascertain as completely as possible its complex of genes and its genic whole.

Cultivation in Russia is concerned not only with extremes of climate, from arctic to sub-tropical, which determine the species of plants that can be grown as crops, but a single species of plant—*e.g.*, Bread Wheat (*Triticum vulgare*)—has to be grown under the most variable conditions of soil and moisture. Russia is exceedingly variable in this respect, the conditions varying with the contour lines from flat plains and grassy steppes to forest hill country and mountains, from arid deserts and irrigated drylands to well-drained fens and swampy marshes, from the light, thin loess lands to the heavy, rich and fertile alluvial soils. Each of these variable conditions of soil and moisture demands a special variety of the species made up of a definite varietal complex of genes. Many of these genes represent ecological or physiological characters vitally fundamental to the success of the crop. In recent years many new varieties have been introduced into old countries containing genes for increased yield, early maturity, resistance to disease, and other desirable qualities, but these are often found to be ill-adapted ecologically for the local conditions of the district into which they have been introduced. The old local varieties containing these ecological genes have for the most part been displaced by modern varieties and are either lost altogether or are hidden away in obscure and inaccessible places.

It is the aim of the Russian plant breeders to discover these old local races, and by crossing them with modern varieties, to breed new and virile races containing the old and new genes in such a way that the good qualities of the modern varieties are added to the vital ecological qualities of the old local races. This entails a systematic investigation of the old and new genes peculiar to each species of crop in a large series of breeding experiments, which are only possible after an extensive and intensive geographical search for old varieties of the species, both cultivated and wild. From this it will be seen that the Russian plant-breeding experiments are entirely dependent on the previous collection of geographical genes in the forms of old and new, local and foreign, and cultivated and wild varieties of each of the species under investigation.

Thanks to the initiative of Dr. Vavilov and the support of the Government, the Russians have, during the last decade, carried out this search for geographical genes on an extensive scale and in the most systematic way, not only in their own country but over a great part of the Old and New Worlds. Expeditions have been sent out to various parts of Russia, Asia Minor, the Caucasus, Transcaucasia, Turkestan, and Siberia, as well as the outlying areas of Sin-Kiang and Mongolia, N.W. India, Afghanistan, Persia, and Abyssinia, while in the New World in 1925 and 1926 expeditions were sent out to Mexico, Guatemala, and Colombia, and in 1927 and 1928 to Peru, Bolivia, and Chili. Dr. Vavilov himself has accompanied several of these expeditions and has also investigated the flora and cultivations of Canada and the northern regions of North America as well as the sub-tropical districts of Florida, Louisiana, Texas, California, Mexico, and Guatemala.

This is not the place to relate in detail the remarkable scientific and practical discoveries made by Vavilov (1929, 1930, A, B, C, and 1931 A, B, C,) and his colleagues in these expeditions. It is sufficient to note in passing that, for each species investigated, primary regions or centres of origin were discovered containing the maximum density and diversity of wild varieties carrying mostly dominant genes, including endemic varieties carrying dominant genes not found elsewhere. In these primary centres varieties of cultivated plants were characterized by a lack of divergence, while towards the periphery of the main ancient area occupied by the cultivated species recessive forms singled out, mountains and islands playing an important rôle in the isolation of new varieties.

The main point is that in the different species investigated in these Russian world expeditions many hundreds of new varieties, both wild and cultivated, have been introduced into Russia, and these contain many thousands of new and valuable genes. These are being utilized and exploited by the Russian plant breeders and geneticists in their inter- and intra-specific crossing and selection experiments, and will in the course of a few years, by innumerable Mendelian recombinations of genes, X-ray mutations of genes and transmutations of chromosomes (Hurst, 1931), provide a host of new and improved races suitable for cultivation under the multifarious conditions of Russian agriculture. Naturally, sufficient time has not yet elapsed to bring to full fruition the results of these Russian expeditions in search of new genes, but the projected plant-breeding experiments are well on the way and according to plan, so that a few notes on their progress during the last two years may be useful to breeders in other parts of the world.

Plant breeding in Russia is organized in the form of an Institute of Plant Industry at Leningrad, under the direction of Dr. Vavilov. The Institute is a part of the Lenin Academy of Agricultural Sciences in U.S.S.R. An illustrated *Bulletin of Applied Botany, Genetics, and Plant Breeding* (originally founded by Robert Regel) is published by the Institute in Russian and English, and has now reached its twenty-sixth volume (1931). It is, of course, impossible in a short article to do justice to the whole of the Russian experiments in plant breeding during the last decade, but a brief abstract is given of some of the more promising experiments carried out during the last two years.

COTTON BREEDING.

The Russian expeditions to Central and South America discovered some interesting and useful varieties of cotton, and Dr.

Vavilov's (1931 B) remarks on some of these are highly suggestive. According to him the species of cotton, *Gossypium hirsutum* L., grown in the United States of America originated from Mexico, and the best modern varieties, "Acala," "Texas," "Big Boll," and "Durango," were directly obtained from Mexico and do not differ at all from the initial varieties of that country. A species of cotton, *G. Palmeri* Watt., allied to *G. hirsutum* also comes from Mexico. For cotton growing in general, Mexico is of exceptional interest, since most of the best varieties are based on the Mexican Uplands Cotton (*G. hirsutum*) with its earliness, strength of lint, and high yield. Europe and Asia obtained their initial varieties of cotton from the United States of America, whose varieties are not sufficiently early for Russian conditions. The earlier varieties needed are to be found in the Highlands of South Mexico or in the mountains of Guatemala. The Russian expedition, however, found that the collection of these early varieties was not so easy, since the commercial cotton growing of North Mexico and the United States of America during the last decade has nearly killed the local cotton production in South Mexico and Guatemala.

Vavilov believes that prolonged expeditions in search of relics of primeval cotton cultivation would be of great value in discovering lost genes. The Russian expedition found great diversity among the local Uplands Cotton of South Mexico, including varieties with different coloured fibres, hairy and almost glabrous leaves, yellow and cream-coloured flowers, leaves of different shapes, high yielders and comparatively early races. Vavilov finds that a considerable part of the plant resources of the world owes its origin to this region of Central America, including cotton, maize, and potatoes. Other cottons found there were the wild and cultivated species *G. hypodenium*, *G. patens*, *G. contextum*, *G. dicladum*, and *G. Morillii* of Cook and Hubbard.

The Russian expedition to South America found a secondary centre of origin in Peru, the seat of a very ancient agriculture, the chief species being potatoes, tomatoes, and the cotton *G. peruvianum*. The cottons of Peru and Brazil form an individual group of species differing from the Mexican Uplands in their genes, although all have the same chromosome number 52, which is twice as many as the Asiatic species that have only 26 chromosomes. Hybrids between the Mexican and Peruvian species of cotton reveal their incompatibility, giving a disharmonious segregation of genes and characters, a good deal of sterility, and various monstrosities as in other hybrids between distinct species and genera. The fact that hybrids can be raised between the Mexican and Peruvian cottons is, however, of much interest, and if the body or germ cells of these hybrids are X-rayed (Hurst, 1931) chromosome duplications may arise which will produce a fertile new species combining the characters of the Mexican and Peruvian cottons, as the wheat-rye, radish-cabbage, and other hybrids (Figs. 1, 2, and 3). In such a case the chromosome number of the new species would be 104 instead of 52, which would increase the possibilities of variation and give new combinations of genes which might prove of inestimable value to cotton growers, just as some of the American varieties with 52 chromosomes are superior to the Asiatic varieties with 26 chromosomes.

Recently an extraordinarily interesting generic cross has been effected by Harland and Atteck (1931) between the Arizona cotton *Thurberia* with 26 chromosomes and the Sea Island *Gossypium* with 52 chromosomes. Mature F_1 plants were raised all of which were sterile. If these plants should duplicate their chromosomes either naturally or under the influence of X-rays, a new and fertile genus of cotton would be created with 78 chromosomes, giving the plant breeder a set of new genes to exploit. It is interesting to note that in the new generic hybrid between *Thurberia* and *Gossypium* the petal spot of *Thurberia* is recessive and not dominant as is usual in *Gossypium*. This fact suggests many possibilities.

The chief centre of Russian cotton growing is at Tashkent and Fergana in old Turkestan. .Tashkent is the seat of a great Irrigation Institute, and by its engineering efforts the barren, dry steppes have in seven years been changed into a fertile cotton-growing area which is said to grow cotton equal in quality to the best American Sea Island and to have increased Russia's production from 1 million to 2 million bales a year. At Pachta Aral there is a cotton farm of 27,000 acres. At Fergana, where Egyptian cotton is grown, Professor Zolotov is said to have produced as much as 5,000 lbs. of marketable cotton per acre. Near by is the largest cotton-seed oil factory in Russia, which is said to produce 400 tons of cotton-seed oil per day. At the Cotton Research Institute at Tashkent some interesting breeding experiments are being carried on by Vycotski, Bel-Kuznjetcova, Zhurbin, and others.

Vycotski (1930), by raising interspecific cotton hybrids, is endeavouring to combine the valuable lint of Egyptian cotton (*G. barbadense*) with the earliness, strength of lint, and high yield of the Mexican Uplands (*G. hirsutum*). By crossing the Uplands cotton with *G. herbaceum*, he hopes to raise reliable drought-resisting, productive cottons with heavy bolls. Altogether he has made 80,000 pollinations and raised 75 different lines of crosses. He finds that crosses between species with the same chromosome number are very easy, but vary with the variety used. Thus, 1,000 crosses between No. 169 Uplands with 52 chromosomes and No. 0671 Egyptian with 52 chromosomes gave 9,330 hybrid seeds, while in the same number of crosses between No. 0100 Uplands and No. 0671 Egyptian only 3,328 hybrid seeds were obtained. All the first generation hybrids (F_1) were completely sterile, both selfed and back-crossed to the parents, and various methods of producing fertility have been tried, including the use of narcotics, but so far without success. Successful crossings between the species of the New and Old Worlds were extremely rare, although natural crossings between these species in the field occur occasionally even without emasculation of the female parent.

Bel-Kuznjetcova (1930) reports the preliminary work at Tashkent in the artificial induction of mutations of genes and transmutations of chromosomes in the cotton plant by various means such as X-rays, radium, low temperatures, and narcotics. So far, thirty-two lines of different botanical groups have been X-rayed. The cotton plant appears to display a greater tolerance of these agencies than many other plants. Zaitzev (Zhurbin 1930) succeeded in combining the quality of lint of the American cottons with the early ripening necessary for cultivation in Turkestan. Zhurbin (1930) also reports that attempts to breed absolutely self-fertilized types of cotton by breeding short-styled varieties and by other methods have so far failed. At the Central Agricultural Experiment and Plant Breeding Station of Azerbaijan selection is being made of introduced varieties carrying foreign genes, and hybrid populations of cotton, for the purpose of combining component genes which will produce yield and quality. The chief of these are genes for early ripening, size of boll, disease resistance, and adaptation to poor cultural conditions; quantity, length, strength, and uniformity of lint, and oil content of seed. This Station is also investigating the artificial induction of mutations and transmutations and the raising of interspecific hybrids. Finally, Varuntsjan (1930) is engaged in the production of wilt-resistant forms and drought-resistant varieties in order to extend the area of cultivation. Preliminary tests indicate that late ripening varieties are more resistant to drought than the early varieties which are commonly grown under irrigated conditions.

NEW FIBRE PLANTS.

Berland (1930) is engaged in the pioneer work of breeding new fibre plants as possible substitutes for cotton, jute, manilla hemp, and allied plants. A promising species for this purpose is *Apocynum venetum*, a variable species, two distinct types of which are found in Russia in different regions. The plants of this species are strictly self-fertile and can also be vegetatively reproduced as clones. Pure lines can be raised and new forms built up quickly. The characters aimed at are long thin stems, few branches, rapidity of growth, two crops a year with high percentage of fibre of uniform length and strength.

Another promising species for this purpose is *Hibiscus cannabinus* from Persia. Four race groups have been established, differing in earliness from 90 to 150 days, and 16 varieties have been selected for earliness, high yield, and quantity of fibre. This species is naturally self-fertile, so that progress in breeding should be rapid and easy.

A further species, and perhaps the most promising of the three, is *Abutilon avicennae*, with a great number of varieties differing in earliness and length of stem (60-110 days and 1·5 – 4 m.). The species is naturally self-fertilized, and forms have been selected with high yield, early ripening, and large fibre production. It will be interesting to follow this pioneer work in attempting to breed new fibre plants.

WHEAT-RYE HYBRIDS.

The most interesting and important of the Russian grain-breeding experiments are probably those of the generic hybrids between wheat (*Triticum*) and rye (*Secale*), which have been carried out on a large scale with considerable success. The chief interest lies in the fact that the parents belong to two distinct and well-known genera, both of which are used for the important purpose of making flour and bread which is not only the staff of life but the hall-mark of civilization. Wheat and rye are grown on a large scale in Russia and other continental countries, and the problems of their cultivation are vital to all. From the scientific and evolutionary point of view generic hybrids between wheat (*Triticum*) and rye (*Secale*) are of extraordinary interest, since rye (*Secale cereale*) is a diploid species with 14 chromosomes, while the bread wheat (*Triticum vulgare*) is a hexaploid species with 42 chromosomes. Hybrids between the two are of course tetraploids with 28 chromosomes, since rye has 7 germinal chromosomes and bread wheat 21. The cross is often difficult to make and relatively few hybrids are formed, especially when wheat is used as the pollen parent; on the other hand, when rye varieties such as "Rosen" or "Dakold" are used as the pollen parent 100 per cent. fertility has been recorded. On the whole the hybrid of the first generation between wheat and rye may be said to be intermediate, though numerically the wheat characters predominate—*e.g.*, according to Oehler (1931), out of 21 external characters of the whole plant, wheat characters were dominant in 10, rye in 3, and the remaining 8 were intermediate. The hybrid is characterized by luxuriant growth often surpassing both parents, although it is very sterile and lacking in viable pollen. Usually it is completely sterile when selfed, but back-crosses can be made with both parents, particularly with the wheat parent, but usually with some difficulty. The back crosses with wheat segregate into wheat-like, wheat-rye, intermediate, rye-wheat, and rye-like ear types. The wheat-like types are usually hexaploid with 42 chromosomes as in the wheat parent; these are fertile and give a wheat reaction to brown rust. Some of the wheat segregates give baking tests better than standard and good yields. Some are awnless, winter-hardy, and very early, and may be suitable for cultivation in the dry rye belt where wheat does not usually thrive. The intermediate types of the back-cross like the original F_1 hybrid are usually tetraploid with 28 chromosomes, and like it are very sterile, 43·4 per cent. being completely infertile and the rest of low fertility. In the Russian experiments, however, reported by Tjumjakoff (1930), Meister (1930), and Levitsky and Benetzkaia (1930), several of the intermediate F_1 hybrids of wheat and rye showed an unusual degree of fertility, and two families of these were examined cytologically and found to be octoploid with 56 chromosomes.

From this it is evident that at some stage the chromosomes of the tetraploid hybrid with 28 chromosomes were duplicated, giving rise to octoploids with 56 chromosomes. These bred true to the intermediate wheat-rye characters in the second, third, and fourth generations, demonstrating that a new octoploid genus *Triticale* has been created which is neither wheat (*Triticum*) nor rye (*Secale*), but combines the characters and chromosomes of both genera as in the case of the Ægilops-wheat hybrid of Tschermak known as *Ægilotricum* and the radish-cabbage hybrid of Karpechenko known as *Raphanobrassica* and others with a similar origin (Hurst, 1931). The experimental creation of these new species and genera is one of the most interesting and important features of modern plant breeding, and the Russian plant breeders now have the creation of

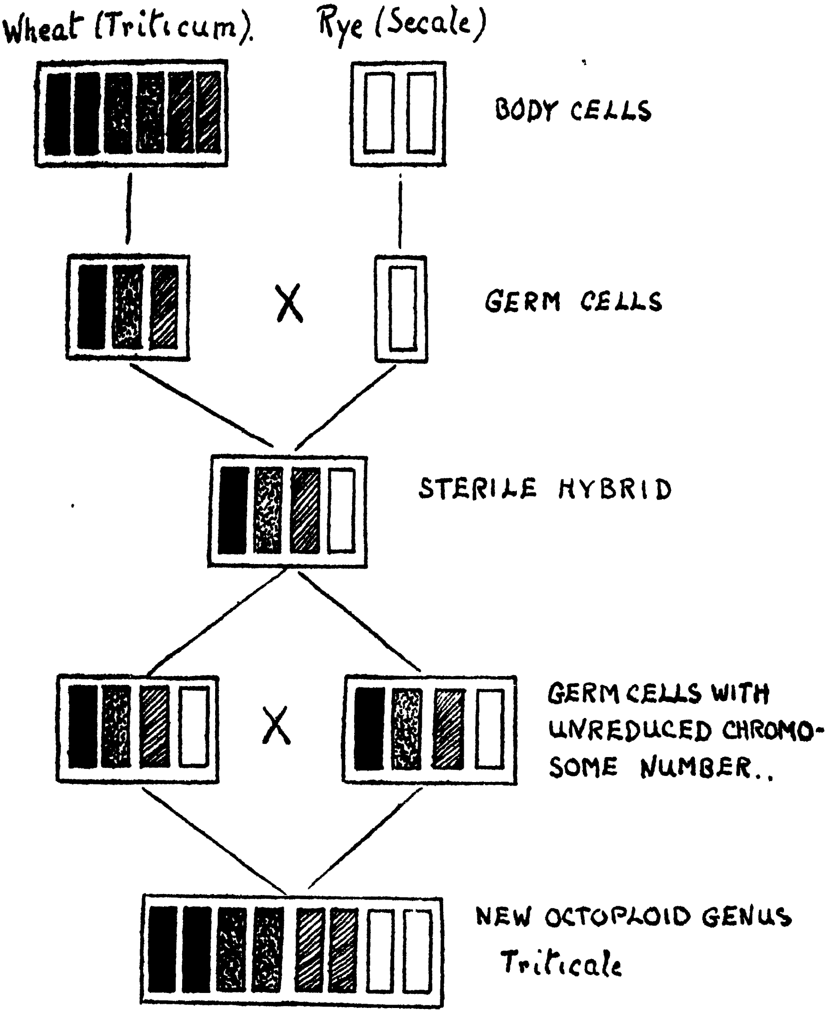
Wheat (Triticum).
Rye (Secale)
BODY CELLS
X
GERM CELLS
STERILE HYBRID
X
GERM CELLS WITH UNREDUCED CHROMOSOME NUMBER..
NEW OCTOPLOID GENUS Triticale

FIG. 1.—The experimental creation of a new genus *Triticale* (Wheat-Rye) by hybridization of *Triticum* (Wheat) with *Secale* (Rye), followed by duplication of chromosome sets.

The first species of the new genus is *Triticale saratoviense*, which is an octoploid with 8 sets of chromosomes (56) derived from *Triticum vulgare*, a hexaploid with 6 sets of chromosomes (42) and *Secale cereale*, a diploid with 2 sets of chromosomes (14).

The inner blocks represent distinct sets of chromosomes (genomes).

two new genera to their credit. Fig. 1 shows how the new octoploid genus *Triticale* has been made from the hybridization of the diploid and hexaploid species of two other genera, *Triticum* (wheat) and *Secale* (rye). Karpechenko (1930) has even carried his experiments a step farther by the hybridization of his radish-cabbage, *Raphanobrassica Karpechenkii*, with the turnip (*Brassica campestris*), the Abyssinian mustard (*B. carinata* Braun), the swede turnip and colza rape (*B. napus* L.), the wild radish (*Raphanus raphanistrum* L.), and with the Chinese cabbage (*B. pekinensis* Rupr.). All the hybrids were normally developed vigorous plants with intermediate characters, and their chromosomes combine the sets of three distinct species belonging to two distinct genera. Those which flowered the first year produced a few seeds, and next year it is expected that fertile forms will arise with duplicated chromosomes giving rise to a new fertile constant hexaploid species of *Raphanobrassica* combining the characters of three species and two genera, as shown in dotted lines in Fig. 2, which gives the pedigree of the radish-cabbage-turnip combination showing how it may be formed.

Popova (1930) also reports the raising of seven generic hybrids between species of *Ægilops* and *Triticum*, and it is possible that these also may lead to new species of *Ægilotricum*.

THE RUSSIAN EXPEDITIONS.

In addition to the various cotton species brought back by the Russian expeditions to Central and South America and noted above, many other useful varieties and species were introduced to Russia for the use of the plant breeders; space will only allow a few of these to be mentioned.

Vavilov (1930 A) states that on the western spur of the Pyrenees scores of varieties of oats (*Avena brevis* and *A. strigosa*) were found where only two or three have been known over a large area.

The expedition to Abyssinia revealed numerous varieties of barley (*Hordeum*), which will be of great value to cultivators in certain districts of Russia and for breeding experiments.

It is believed that the common potato (*Solanum tuberosum*) with 48 chromosomes came originally from Chili in South America, but in Mexico and Central America the Russian expeditions found more than 30 tuber-bearing species of potato, some of which are genetically near to the common potato. The Mexican wild species comprise a whole set of polyploids with 24, 36, 48, 60, and 72 chromosomes. Some South Mexican species cross easily with the common potato, and two of these are immune to blight (*Phytophthora*) and other

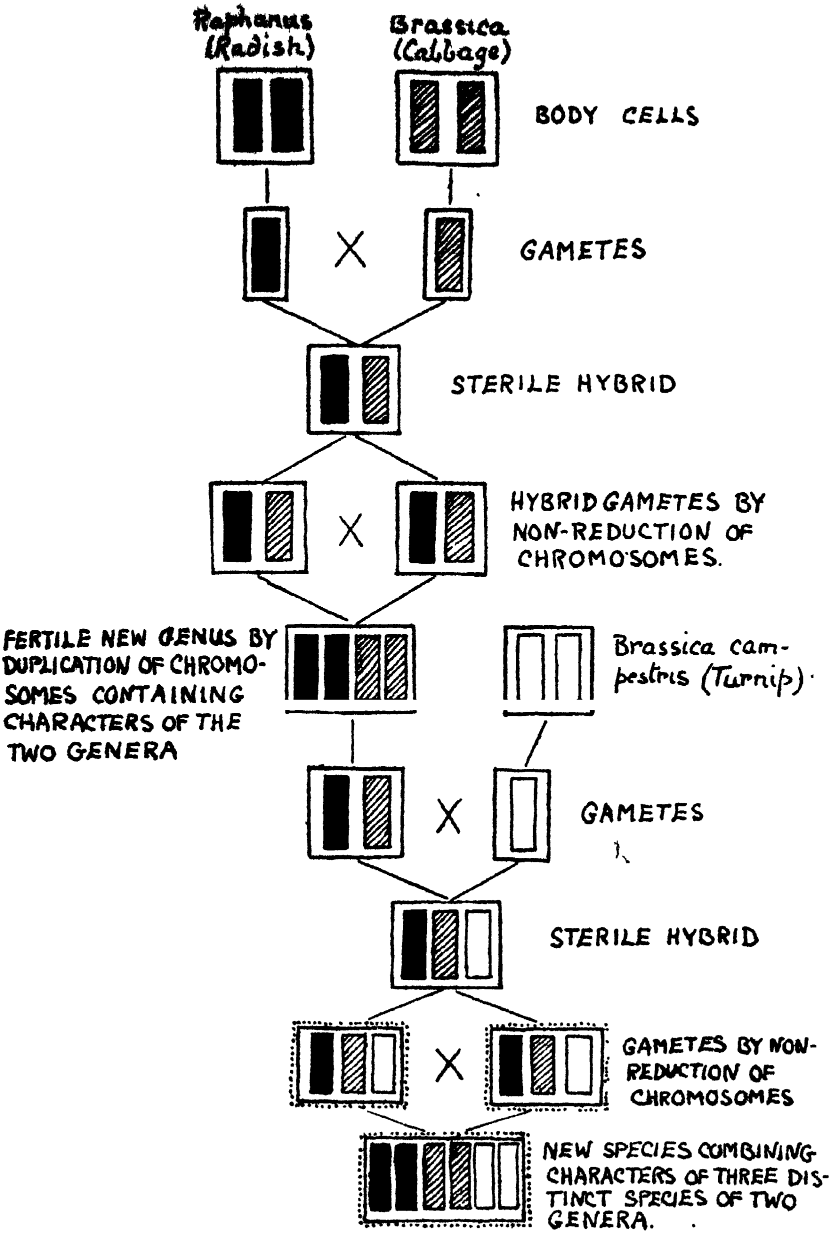
Raphanus (Radish)
Brassica (Cabbage)
BODY CELLS
GAMETES
STERILE HYBRID
HYBRID GAMETES BY NON-REDUCTION OF CHROMOSOMES.
FERTILE NEW GENUS BY DUPLICATION OF CHROMOSOMES CONTAINING CHARACTERS OF THE TWO GENERA
Brassica campestris (Turnip)
GAMETES
STERILE HYBRID
GAMETES BY NON-REDUCTION OF CHROMOSOMES
NEW SPECIES COMBINING CHARACTERS OF THREE DISTINCT SPECIES OF TWO GENERA.

FIG. 2 (above).—The experimental creation of the new genus *Raphanobrassica* Karp. (Radish-Cabbage), by hybridization of *Raphanus sativus*, L. (Radish) with *Brassica oleracea*, L. (Cabbage), followed by duplication of chromosome sets.

(below).—The process of formation of a new species of *Raphanobrassica*, Karp. (Radish-Cabbage-Turnip) by hybridization of *Raphanobrassica Karpechenkii* (Radish-Cabbage), with *Brassica campestris*, L. (Turnip), followed by duplication of chromosome sets.

Inner blocks represent distinct sets of chromosomes (genomes). Dotted lines represent part of experiment not yet completed.

diseases. The Russians also found another series of wild species of potato in Mexico and South America, especially in Peru and Chili; some of these carry new genes which, when selected and crossed, may have great potential value for cultivation in Russia and elsewhere.

The expeditions to Central America disclosed a wonderful richness of types of maize, especially varieties of Dent Corn, and the Russian plant breeders are now engaged in testing and breeding these forms for different parts of the country. A number of curious types have already been raised which have a potential value for cultivation and further crossing. The character of number of rows in the cob seems to be of considerable importance. The highest yield is found with the 16-rowed type, but for full maturity in adverse climates the earlier and smaller 12-rowed type must be grown in many parts of Russia.

Vavilov (1929) found Afghanistan to be the chief centre of origin of the pea on account of its great diversity and wealth of varieties and dominant genetical characters. The expedition to Abyssinia revealed a secondary independent primary centre of the pea (*Pisum*) in the mountains of Abyssinia, where the greatest richness and variety of forms were found only in certain small areas at high altitudes where also endemic dominant genes were found. In one place as many as 15 sub-species out of the 20 known were found. Passing from this centre towards the north and lower altitudes, there is a gradual change to varieties in which the dominant genes gradually diminish and the recessive genes constantly increase.

On crossing the African species with the Asiatic species a tremendous range of forms has been obtained in the second generation, indicating a great wealth of genes from the two distribution centres and the possibility of securing valuable new forms by selection and further crossing. Five new genes for flower colour have already been found in the genetic tests, and certain genes are found to be identical in both centres. Some forms ripened much earlier than all the others, and these are expected to prove of great value for further crossings.

Vavilov (1930 B) has traced the centre of origin of the cultivated fruit trees of Europe and China to the wild species and genera of Transcaucasia, Turkestan, and the Caucasus. No less than 80 wild species of fruits and nuts have been found in the Caucasus, while Transcaucasia is the centre of distribution of the cultivated grape vine and many other fruits. Turkestan is as rich in species as the Caucasus, but varieties are not so numerous. Europe and China are on the periphery of these central areas with forms carrying a

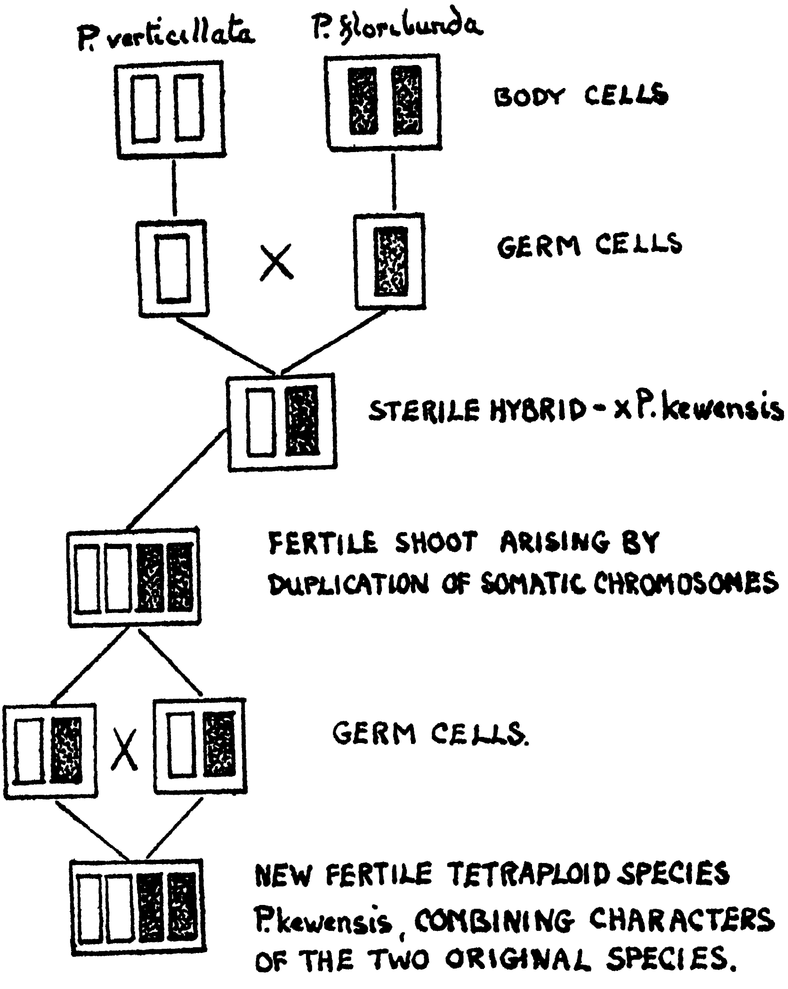
P. verticillata
P. floribunda
BODY CELLS
X
GERM CELLS
STERILE HYBRID - x P. kewensis
FERTILE SHOOT ARISING BY DUPLICATION OF SOMATIC CHROMOSOMES
X
GERM CELLS.
NEW FERTILE TETRAPLOID SPECIES P. kewensis, COMBINING CHARACTERS OF THE TWO ORIGINAL SPECIES.

FIG. 3.—The formation of the new tetraploid species *Primula kewensis* by the hybridization of the diploid species *P verticillata* with the diploid species *P. floribunda*, followed by the *somatic* duplication of chromosome sets. This provides an alternative process in the evolution of new species from the hybridization of old species.

The inner blocks represent distinct sets of chromosomes (genomes).

diminished number of dominant genes and a great excess of recessive genes. The Institute of Plant Industry in Leningrad is making a special investigation of fruit trees and fruit growing, and appeals for the collaboration of scientific workers all over the world. Rich genetical herbaria have been accumulated, including thousands of specimens for each species, and special nurseries have been laid out for growing on the various forms collected by the Russian expeditions.

One of the problems of fruit culture is the genetical problem of gigantism, which is frequently found in cultivation in polyploid varieties of a single species (autopolyploids), while, on the other hand, wild polyploid species made up of more than one species (allopolyploids) usually show considerable dwarfing. The Russian workers in fruit breeding are too numerous to mention by name, and since the work is very slow genetically very little has been published since the expeditions were sent out. There is no doubt, however, that in a relatively short time great advances will be made by the Russian fruit breeders with their unique and rich material.

GENERAL PLANT BREEDING.

Finally, although it is impossible to deal with the whole field of Russian plant breeding, mention may be made of a few other interesting features so far as space allows.

Naturally a great deal of research has been done with wheats for the purpose of breeding local races such as an awnless wheat for the steppes. Many experiments have been made in hybridizing various species of polyploid wheats, including *Triticum persicum.*

A considerable amount of research has been devoted to the hybridization of the different species of polyploid oats with an examination of their chromosomes, and an early race which yields well has been bred.

The barleys of Daghestan have been analyzed and found to be extremely variable, and the important question of natural crosses in oats and barley has been investigated and demonstrated.

In sugar beets the yield and sugar content have been definitely increased by selection and breeding, mainly through the isolation of self-fertile races which makes inbreeding easy (*Cf.* Hurst, 1925).

The breeding of flax for fibre has proved successful under new methods of selection in which phytopathology and technology play a leading part.

Hop breeding is carried out at the Agricultural Academy of Timiriazev, and the importance of resin content has been stressed.

Potato breeding on a large scale is carried on at the Agricultural Experiment Station at Nossovka, and an intensive study of vegetative mutations in tubers has been followed up with great care.

Geographical forms of rye have been studied and the chromosomes of beans have been investigated.

A good deal of work has been done in sunflower (*Helianthus*) breeding, and hybrids between annual and perennial species have given interesting results, and bud mutations in the tubers of these hybrids (F_1) have been found. Races resistant to the parasite *Orobanche* and also to insects have been bred with much success in these sunflowers.

Fertile hybrids in tobacco (*Nicotiana*) have been investigated genetically and cytologically, and species hybrids of poppies (*Papaver*) have given interesting results. Lupin breeding has been carried on at Novosybhov with success, and the heading and yield of cabbages has been worked out genetically. Medicinal plants such as peppermint and black mallow have been bred as pure lines and hybrids, which is quite a new feature.

The breeding of the tea plant has been successfully carried out in Cakva, and isolated plants have produced selfed seeds which should lead the way to a useful system of inbreeding and selection of improved varieties.

The climate of Russia is of course quite unsuitable for the growth and cultivation of tropical rubber, but the Guayule rubber (*Parthenium argentatum* Gray) collected in the sub-tropical mountains of Northern Mexico by the Russian expedition is said to grow and thrive well in the Black Sea region. Eight constant groups have been selected for cultivation and breeding.

In conclusion it is evident, even from the brief account of Russian plant breeding given above, that a great deal has been and is being done at the Russian Plant Breeding Stations, and when the time is ripe for the utilization and exploitation of the thousands of foreign genes introduced by Vavilov and his colleagues from the various and world-wide Russian expeditions, we may expect to see vast progress in plant breeding in the future.

Vavilov's conception of a species originating and starting from a primary centre of distribution and in course of time reaching a wide periphery, bears a striking resemblance to the principle of "Age and Area" enunciated by Willis (1922). Indeed, Vavilov's theory of evolution may be fittingly described as a genetical or varietal aspect of "Age and Area." Vavilov deals with the many varieties of each species, while Willis deals with the many species of each genus and family. Both aspects are necessary for a full understanding of the problems of distribution in space and time and of the evolution of species in Nature.

REFERENCES

BABCOCK, E. B. 1931. *Amer. Nat.*, vol. lxv., p. 5.

BEL-KUZNJETCOVA, V. 1930. *Bull. Sci. Res. Cott. Inst., Tashk.*, vol. v., p. 18.

BERLAND, S. S. 1930. *Proc. U.S.S.R. Congr. Gen.*, vol. iv., p. 49.

HARLAND, S. C., and ATTECK, O. S. 1931. *Amer. Nat.*, vol. lxv., p. 380.

HURST, C. C. 1925. "Expts. Genetics" (Cambridge Univ. Press), pp. 385 and 544.

HURST, C. C. 1927. *Science*, March 28.

HURST, C. C. 1928. *Rep. Int. Congr. Gen., Berlin*, 1927, vol. ii., p. 871 (*Suppl. Zeitschr. induk. Abstr. Verer.*).

HURST, C. C. 1931. EMPIRE COTTON GROWING REVIEW, vol. viii., p. 103.

KARPECHENKO, G. D. 1930. *Proc. U.S.S.R. Congr. Gen.*, vol. ii., p. 277.

LEVITSKY, G. A., and BENEZTKAIA, G. K. 1930. *Proc. U.S.S.R. Congr. Gen.*, vol. ii., p. 345.

MEISTER, G. K. 1930. *Proc. U.S.S.R. Congr. Gen.*, vol. ii., p. 27.

OEHLER, E. 1931. *Z. Zuchtung A.*, vol. xvi., p. 357.

POPOVA, E. M. 1930. *Proc. U.S.S.R. Congr. Gen.*, vol. iv., p. 303.

TJUNJAKOFF, N. A. 1930. *Proc. U.S.S.R. Congr. Gen.*, vol. ii., p. 497.

VAVILOV, N. I. 1929. "Agric. Afghan.," chap. xviii.

VAVILOV, N. I. 1930. (A) *Proc. U.S.S.R. Congr. Gen.*, vol. ii., p. 5.

VAVILOV, N. I. 1930. (B) *Rep. Proc. 9th. Int. Hort. Congr., London* (B), p. 271.

VAVILOV, N. I. 1930. (C) *Rep. Int. Congr. Bot., Cambridge.*

VAVILOV, N. I. 1931. (A) *Bull. Appl. Bot. Gen. and Pl. Br.*, vol. xxvi., p. 31.

VAVILOV, N. I. 1931. (B) *Ibid.*, vol. xxvi., p. 179.

VAVILOV, N. I. 1931. (C) *Ibid.*, vol. xxvi., p. 271.

VARUNTSJAN, I. 1930. *Khlopkovoe Djelo* ("Cotton Industry"), vol. ix., p. 1026.

VYCOTSKI, K. 1930. *Bull. Sci. Res. Cott. Inst., Tashk.*, vol. i., p. 26.

WILLIS, J. C. 1922. "Age and Area."

ZAITZEV. 1930. *See* Zhurbin. 1930.

ZHURBIN, A. J. 1930. *Bull. Sci. Res. Cott. Inst., Tashk.*, vol. i., p. 22.

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BLACKARM DISEASE OF COTTON IN UGANDA

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[The following description of observations on blackarm disease in Uganda has recently appeared in the " Report of the Department of Agriculture, Part II., for the year ended 31st December, 1930." In view of the fact that the Note may be of interest to cotton workers in other countries, the Corporation obtained permission from the Uganda Government to reprint it. The Corporation are glad to avail themselves of this opportunity to convey their thanks both to the Government and to the author for so readily according this permission.]

THE following account has been prepared with the assistance of Mr. G. W. Nye, Cotton Botanist, and of Mr. C. E. J. Biggs, Agricultural Officer, to whom I am much indebted for their valuable help and criticism. It will be understood that the account is merely an attempt to summarize our observations on this disease in Uganda during 1929-30 and 1930-31, and that the hypotheses put forward may be entirely revised or rejected as further experience of the disease is accumulated. It is not suggested that these hypotheses are applicable to other cotton-growing countries.

1. GENERAL.—Prior to Snowden's publication on the " Occurrence of Angular Leaf Spot of Cotton in Uganda " in 1926, we have little evidence regarding the distribution of the disease here. A number of records of damage to cotton by an unidentified disease are contained in various reports of Agricultural Officers. There is indication that some of these reports may refer to this disease. Apart from these reports, the first definite record is that of Snowden referred to above, the disease being described as common during the 1925-26 season. Since then more records are available. During the 1926-27 season the cotton at Serere Plantation was badly affected by hailstorms, but a considerable amount of blackarm was present in addition. During the following season, 1927-28, little damage was reported from this disease.

During 1928-29 the cotton crop in the northern and eastern parts of Teso district was severely affected and a very small crop was produced.

The 1929-30 season will be remembered as that in which the disease first became of primary importance in the Protectorate, in so far as it occasioned a great loss of crop over a wide area in the most important cotton-producing parts of the Eastern Province. The area affected was much larger than that of the preceding season, and extended over the whole of the Eastern Province with the exception of the wetter area around Mt. Elgon and the Nile part of Busoga.

The general appearance of the cotton plots in the severely affected districts was pitiful, the plants in many plots being dwarfed and stunted, having shed the primary leaves and developed a mass of short shoots and tiny leaves, many of these being deformed and rapidly developing a red pigment. Examination of the roots of such plants showed a similar effect, the root system being confined almost invariably to the top 6 inches of soil, with only a thin, underdeveloped main root entering the deeper soil layers.

This poor development of the root system was apparently due to the hard dry nature of the soil below 6 or 8 inches depth, into which the roots were unable to penetrate. From observations made during the 1929-30 and the 1930-31 seasons it would seem that the occurrence of this hard subsoil layer may prove to be one of the major factors in the development of an epidemic of the disease under Uganda conditions.

Examination of a large number of cotton plots in the various districts visited gave evidence that the disease had appeared first in Teso and in the eastern part of Lango, and at a later stage in the development of the plants in areas away from this centre. In some areas of Bugwere district little damage was done before the beginning of January, when the disease suddenly increased and caused the loss of a considerable proportion of the bolls already on the plants by forcing them to open prematurely.

For the 1930-31 season seed was taken from the areas in Busoga where little damage was done by the disease during the previous season, and used to replace the seed in the areas which had then suffered more severely. Examination of plots in Teso during the early part of the season showed that in spite of this change of seed there was an appreciable amount of infection on the cotyledons and young leaves of the seedlings. In almost every plot there were a few plants showing leaf infection, and in consequence of this it was feared that a repetition of the severe infection of the previous season was to be expected. At this stage, however, no sign of the stem form of the disease was discovered. As the season progressed the angular leaf spot form of the disease increased in incidence all over the country, and some cases of stem infection were reported, though in most cases these were stated to be occasional and not partaking of the nature of an epidemic as in the previous season.

In the Kampala district leaf infection began to show a rapid increase during late September, this increase continuing through October. During November the increase of infection slowed down, and in December and January the infection gradually dwindled away to small amounts by the natural shedding of the older infected leaves of the plants. By the middle of February the infection was limited to only a few leaves on most plants, an occasional exceptional plant still showing infection on most of its leaves. During the whole season stem infection was comparatively rare, and only occasionally severe enough to affect the development of the plant.

Reviewing the history of the disease during this 1930-31 season, it may be stated that although the causal organism, *B. malvacearum*, was generally distributed all over the country, even in the early stages of the crop, and though it subsequently increased in incidence until every cotton plant showed infection, in very few areas did stem infection become at all important in its incidence, and during the fruiting stage of the crop the infection gradually died out, with the result that a normal, and comparatively clean, healthy crop was obtained.

Infection on the bolls appeared to be less important this year than last, and in consequence fewer reports of the premature opening of the bolls from this cause were received.

2. THE RELATION OF " ANGULAR LEAF SPOT " TO BLACKARM.—During 1930-31 a large number of inoculations were carried out, both in the laboratory and in the field. To summarize the results obtained, it may be stated that by merely spraying a cotton plant with a culture of the causal bacterium, only the leaf spot form of the disease is obtained, and that only under special atmospheric conditions of which a high humidity is all-important.

Spraying plants with *B. malvacearum* during the late evening or in the early morning gave many more infections, but only on the leaves. The amount of infection obtained by this method of inoculation apparently corresponds closely to the rate of evaporation of the water from the suspension after spraying on the surface of the plant. If evaporation is too rapid the suspension apparently dries out before the bacteria can penetrate through the stomata and infect the plant. If the tissues are wounded infection is not so clearly dependent on atmospheric conditions. In all experiments where the bacteria were sprayed on undamaged tissue of the plant infection was limited to the leaves and bracts of the bolls. No case of infection on the stems or branches or on the boll wall has been obtained under such conditions. On the other hand, if the surface is damaged infection readily takes place on any aerial part of the plant.

Under natural conditions in the field, in a plot kept under observation, over 75 per cent. of the total blackarm lesions found in the plot bore a definite relation to infected leaves. In these cases the lesions had obviously started at the junction of the petiole with the stem and had spread downward through the cortex and phloem tissues from this point.

Following up this observation it was found that leaf infection can be divided into two types, both of which have been obtained by simple spraying of the leaves under moist conditions. The first type of leaf infection consists of scattered angular spots over the blade, and apparently this type of infection is not related to the development of stem lesions at the base of the petiole.

The second type of leaf infection often appears on the leaves at an earlier stage in their development than is the case with the former type of infection, though this does not always happen. When the leaf is mature the lesions are seen to be limited to the tissues along the main veins, with extensions from them into the blade of the leaf. In many cases the whole leaf is deformed and wrinkled, obviously a result of the infection having taken place while the leaf was comparatively young and having prevented normal extension of the main veins, while the unaffected tissues of the parts of the blade between these veins continued their development. This appearance somewhat simulates the " leaf curl " described in Nigeria and the Sudan, but closer inspection reveals no proliferation on the lower surface of the veins, which is considered the chief diagnostic character of this serious virus disease. No evidence of the presence in Uganda of this " leaf curl " disease has been discovered to date. From observations made during the 1930-31 season it appears that the second type of leaf infection by *B. malvacearum* described above is often followed by the development of stem lesions from the base of the petiole. This extension of the bacterial infection through the tissues of the petiole is apparently dependent to a large extent on atmospheric conditions, as during a long dry period it rarely occurs. Under such dry conditions it would appear that the tissues of the drying leaf and petiole dry out too rapidly to permit of the passage of the bacteria, or alternatively it may be that the development of the abscission layer at the base of the petiole is more rapid under these conditions and cuts off the infection from the tissues of the stem. Observations made during the season

1930-31 indicate that the development of this form of stem infection is common only in showery weather.

In the field another type of stem infection has been observed in some cotton plots, in which the lesions are situated on the branches between the main stem and the first node, and bear no relation to leaf infections. At present the origin of this type of infection is not known, though there is a possibility that hailstorms may play some part in it, as many infections occur on the upper surface of the branches, and are often, but not invariably, associated with damage to the tissues.

Thirty isolations were made during the 1929-30 season from leaf infections, stem infections and boll infections. These cultures were used in inoculation experiments on all aerial parts of the cotton plant during the following season, and though some cultures proved more virulent than others, no constant difference in pathogenicity corresponding to the origin of the culture from stem, leaf or boll could be determined. In other words, there is no constant difference between strains isolated from various parts of the host plant, and all forms of the disease are caused by the same organism.

In culture a certain amount of variation has been observed between the various isolations made, chiefly in the reactions when grown on sugar media, especially those containing saccharose, but the differences do not correspond to the origin of the cultures from leaf or stem, and are characteristic of certain individual cultures only.

3. SYSTEMIC INFECTION OF THE HOST PLANT.—The sole evidence of the spread of the bacterium within the tissues of the host plant under Uganda conditions in 1930-31 is that of the passage of the bacteria through the petiole from the main veins of the leaf into the tissues of the stem. Even here the presence of the bacteria in the petiole is visible microscopically, giving a translucent appearance to the tissues.

Attempted isolations from apparently healthy tissues of the stem, even in the case of plants showing rather severe infection, have given consistently negative results. Hitherto no evidence has been obtained in Uganda in support of the theory of systemic infection of the host put forward by Massey in the Sudan (EMPIRE COTTON GROWING REVIEW, VI., 124, 1929).

4. THE RELATION OF THE DISEASE TO THE INSECT PESTS OF COTTON.—Work on this aspect of the disease has been carried out in collaboration with the Assistant Entomologist. To date no experimental evidence of association or causation between incidence of the

disease and jassid attack, *Lygus* attack, or severe infection by aphids has been obtained. From time to time it has been suggested that jassids might possibly be associated with epidemics of blackarm, but from the negative results obtained hitherto from experiments, it would appear that in such cases of apparent association the insect and disease are independent of each other, except in so far as both are much more severe on weakly plants.

5. Boll Infection.—The lesions observed on the bolls fall into two groups, those at the base of the boll and extending down the pedicel, and those on the boll walls.

During the 1930-31 season boll infections in the field were comparatively rare, and observations on their occurrence and probable origin are as yet too few to allow of any conclusions being drawn from them. Present indications are that the first type of boll infection is correlated with infection of the bracts extending to the base of the boll by way of the tissues of the pedicel.

Inoculations by simple spraying of the bacteria on to the unwounded surface of the bolls failed to give positive results during this season.

6. Infection of Cotton Seed.—Twenty-four samples of seed of the 1929-30 crop from various ginneries were examined in the laboratory for the presence of *B. malvacearum*. Some samples were taken from severely affected areas, others from areas in which little damage occurred. Twenty-five seeds were used for test in each examination, and from the exterior of these eight cultures in all were isolated which corresponded in cultural and pathogenic characters to *B. malvacearum*. Another 25 seeds from each sample were carefully delinted with sulphuric acid, washed, and the husks removed. The contents were surface sterilized with mercuric chloride and after washing in sterile water were transferred to tubes of broth. From these tubes, after an inoculation period of 48 hours, a series of isolation plates were made. No evidence of the presence of *B. malvacearum* in these seeds was obtained. Over 75 per cent. of the seed proved sterile even when left to incubate for five days; others gave cultures of various saprophytic bacteria. In addition 1,000 seeds from each sample were sown as a germination test. A small proportion of the seedlings showed leaf spots due to *B. malvacearum*, but the amount of infection in each sample could not be correlated with the amount of disease recorded in locality of origin. In three samples a few seedlings showed stem infection at the junction of the cotyledons with the stem, and these seedlings without exception finally died. This limited experience with severe seedling infection would indicate that

this type of infection is likely to bear no relation to the subsequent disease history of the crop.

All experience with the disease under Uganda conditions indicates that seed infection is almost entirely limited to the exterior of the seed. Instances of internal infection have been recorded, but these still appear to be exceptional.

Experiments have been carried out with a view to discovering the origin of infection on the seed, but have given no clear results this season.

7. Development of Plants from Infected Seed.—As recorded above, a limited experience in Uganda with infected seed appears to indicate that where seedling infection occurs on the stem it is unlikely that the seedling will grow to maturity. Infection on the cotyledons and leaves appears to have no effect on the subsequent development of the seedlings, and its spread on the aerial parts of the plant depends largely on the meteorological conditions, as discussed below.

8. Relation of the Disease to Meteorological Conditions.—Under Uganda conditions the angular leaf spot form of the disease is almost universal every year, while epidemics of the stem form are comparatively rare and localized. It therefore appears likely that external conditions of climate and soil play a great part in the development of the stem disease, which bears no correlation in incidence with the leaf form.

The development of the stem form of the disease, as a result of the infection from the main veins of the leaf passing down the petiole into the stem, has been described above as occurring only during stormy weather.

As an example of the effect of weather conditions on the disease it may be mentioned that a plot of land on the Bukalasa Plantation was severely attacked during 1929-30 and yielded 25 lbs. cotton per acre. The same plot, with no manurial treatment, yielded 600 lbs. per acre during the 1930-31 season, in spite of the fact that the leaf form of the disease was plentiful at an early stage in the development of the crop.

9. Effect of Blackarm on the Plant.—After stem infection has taken place, its subsequent history in relation to the plant appears to depend entirely on the general health and development of the individual plant, as modified by climatic and soil conditions. In the plot kept under observation during the 1930-31 season it was found that plants growing on poor patches of soil were very susceptible to this form of the disease. The lesions spread rapidly in the cortical tissues

and often completely ringed the stem, with the result that the latter broke off at this point. Subsequently a few of these plants sent out branches from points below the lesions, and then developed in a normal manner, but owing to the great check on the development of the plant as a whole practically no crop was produced. Thus even in such cases of severe infection it is demonstrated that the plant has a considerable power of recovery from the attack of this disease provided climatic conditions are suitable.

In the case of stem infection on more robust plants growing on better patches of soil in the same plot during this season, the lesions formed during wet weather in October rapidly dried out in November-December, and were cut off by cork layers. Such lesions apparently had little or no effect on final crop production during this favourable season.

These observations indicate that under favourable climatic and soil conditions the cotton plant is able to throw off both leaf and stem attacks of this disease and to make a complete recovery. This is supported by evidence obtained in all cotton plots observed in Buganda this season; large numbers of plants showed old dry lesions toward the base of the main stem, having been cut off by cork layers and dried out; the plants subsequently produced a normal crop. This crop recovery during a favourable season is to be contrasted with the great damage caused by the disease in the 1929-30 season, when large numbers of the plants were completely stunted and produced very little crop.

10. Relation to Soil Factors.—The following account has been compiled by the Agricultural Chemist. The great difference between the history of the disease during 1928-29 and 1929-30 and that during 1930-31 in Teso and neighbouring districts was associated with a striking difference in the character of the soil. In the former season, as recorded above, the root development of the plants was severely restricted by the hard dry character of the soil below a depth of about 6 inches. The whole root system of the plants was restricted to the surface layers of the soil, and the roots were unable to penetrate deeper.

The subsoil in these districts is naturally very stiff, and when dry is too hard for adequate penetration by the root system of the cotton plant; when moist the roots penetrate much more easily. Thus the whole development of the plant hinges upon the state of the subsoil at the time when the young roots of the seedling reach it. If it is dry and hard the roots are unable to penetrate it and turn and occupy only the surface layers of the soil, with the result that the plants are liable to be severely affected by comparatively short periods of dry, hot weather.

If during the subsequent months the rainfall is well distributed the plants are able to develop, and as the lower soil layers become moister the roots are able to penetrate them, and more or less normal development of the crop results.

It appears, therefore, that the development of the crop depends largely on the state of the subsoil at the time of planting, and this again is the result of the previous rainy season. If the rains during this season, March to May, are normal in amount and well distributed, continuing into the planting season of June and July, the roots of the seedlings are able to penetrate at once into the subsoil, with the result that the plant is much more resistant to adverse conditions.

To summarize, if the top of the subsoil is dry when the young roots reach it, the crop will develop in a normal manner only if the rainfall is very even and well distributed over the whole of the growing season. If the top of the subsoil is wet when the seedling roots reach it, these can penetrate and a reasonable freedom from disease can be anticipated.

In this connection it is interesting to note that the disease in 1929 started in south-eastern Lango and northern Teso on light soils of poor water-holding capacity. Sowing was started at the first rains after a long dry period, when there was a distinct hard layer of soil at 6 to 9 inches from the surface. After light planting rains there was a pronounced dry period so that the plants had a very poor start. In Buganda the disease occurred on a similar soil under the same conditions.

In 1930 the soil during the planting season was much wetter and the rains were more evenly distributed, with the result that these same areas have yielded better cotton than in recent seasons.

11. VARIETAL RESISTANCE TO *B. malvacearum.*—During the 1930-31 season at Bukalasa careful observations were made by the Cotton Botanist in his breeding plot in order to ascertain whether any varieties were more resistant or more susceptible than others to this disease. Very definite differences were observed—*e.g.*, strains of S.G. 99 families originally derived from the " Allen " variety gave 100 per cent. of leaf infection within three weeks of the first appearance of the disease, whereas B. 31 showed no sign of infection throughout the season, although it had every chance to become infected, being planted between two infected rows, with constant movement of native assistants along the rows while tying flowers every morning.

A further interesting point noticed by the Cotton Botanist is that the indigenous cotton, a strain of *G. brasiliense*, was the only cotton at Bukalasa to be badly attacked by blackarm during this season. This would indicate that the disease must be of recent introduction into Uganda, as otherwise this native cotton would not have survived. Strains of "Allen" have also proved very susceptible to the disease, yet for the period this variety was in general cultivation no records of a bad attack are available, indicating that it is probable that the disease was introduced subsequent to the introduction of Allen cotton, quite probably with the Nyasaland Upland variety.

12. SEED TREATMENT.—During the season 1930-31 a rough test of the effect of delinting seed with sulphuric acid was made at Bukalasa and Serere Experimental Stations. The results are tabulated as follows:

> From observations made at Bukalasa during the early part of the season it appears that the plants originating from treated seed remained comparatively free from angular leaf spot for some time after the plots planted with untreated seed showed considerable infection.
>
> At Serere both treated and untreated plots developed angular leaf spot and blackarm lesions, though the effect on the yield of cotton was not apparent. No difference could be detected between the plots, and apparently no benefit was derived from the treatment of the seed.

13. EFFECT OF SOURCE OF SEED.—As recounted above, for the 1930-31 season the seed used in those parts of the Eastern Province which had suffered severely during the previous season was imported from parts of Busoga where the disease had been much less severe. In this connection it is of interest to note that the Cotton Botanist included in his large series of variety trials a test of this imported seed against seed from the badly diseased crop obtained from the local ginneries. The results showed that in the crop produced, in no case was there any significant difference between the two sources of seed, thus indicating that in a favourable season as regards general history of the disease, the selection of the seed from the most healthy districts available is a secondary consideration, and has no effect on crop produced as long as germination is sufficient to give a good stand of plants.

In the same season a test was made of seed from a badly diseased crop at Katakwe, from a less severely affected crop at Mukura, and from a very slightly affected crop in Buganda. The three samples of seed were sown at Serere and at Bukalasa with the following results:

> At Bukalasa the stand of the Mukura seed was significantly better than that of the other samples; a small amount of angular leaf spot was present during the early stages of the growth of

all the plants, but no stem infection developed. No significant differences in yield were obtained.

At Serere the Senior Agricultural Officer reports that the seed from all three sources produced normal crops, and no difference was apparent between the Katakwe seed and that from Mukura, though the seed from Buganda gave a better yield, probably to be accounted for by the better stand of plants and also possibly by difference in variety. The same officer concludes that given a season in which blackarm does not become epidemic, there is no advantage in importing fresh seed into areas badly affected during the previous year, as long as a good stand can be obtained, if necessary by increasing the seed rate per acre. With this conclusion I am in perfect agreement.

14. Summary.—From the information obtained to date on the behaviour of this disease under Uganda conditions, both from observations in the field and from experimental results, we can only conclude that the development of such an epidemic as that of 1929-30 is chiefly dependent on climatic factors. These factors of climate act directly on the rate of spread of the disease from plant to plant, and on the incidence of stem infection; but their effect is also indirect, through the medium of the soil, by controlling the development of the plant and by modifying its resistance to the disease.

THE LEAF CURL DISEASE OF COTTON IN THE SUDAN

A PRELIMINARY NOTE

BY

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AND

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HISTORICAL.—The Leaf Curl disease of cotton was first noticed amongst Sakellarides (Egyptian) cotton growing in the Gezira area of the Sudan in the season 1923-24, by R. E. Massey and A. R. Lambert.

At this time infected plants were very rare, and an examination of the plants gave no evidence of bacterial or fungal attack, in consequence of which it was assumed by the senior writer (R. E. M.) that the curious malformation of the leaves typical of the disease was akin to the wrinkled dwarfs arising in certain Sea Island strains of cotton. Dried specimens of affected plants were sent in 1924 to Dr. E. J. Butler, C.I.E., F.R.S., Director of the Imperial Mycological Institute, who forwarded samples to Mr. O. F. Cook, the well-known American cotton botanist.

In 1925 specimens were submitted to the senior writer by H. W. Bedford, Asst. Govt. Entomologist, who was at that time stationed in the Gezira, and were described by him as " Leaf Curl " of cotton. The matter remained obscure until the following year, when Messrs. Jones and Mason published an account of two diseases of cotton found in Nigeria [2] known by the names of Leaf Curl and Leaf Roll. These writers expressed the opinion that the specimens sent from this country to the Imperial Mycological Institute were affected by Leaf Curl, a view which was shared by Dr. Butler after the receipt of further specimens from the Sudan in 1928.

The disease was widespread in the Gezira during the season 1927-28, and was also noticed in 1928 at Shambat, some 115 miles further north. Evidence was still scanty as to the nature of the trouble, but the virus theory was accepted by the senior writer, who suggested at this time that the vector was the White Fly, a serious infestation of which had occurred in the Gezira in 1927. Owing to the difficulties experienced in effecting the transmission of the disease at Shambat except by grafting, the position remained obscure until 1930, when successful transmission by Aleurodids was obtained in the Gezira by T. W. Kirkpatrick [3], Asst. Government Entomologist (see later).

DISTRIBUTION.—The severity of the disease varies greatly amongst different varieties of cotton growing in the same area, and also different degrees of infection are found in cotton of the same variety growing in different localities—*e.g.*, while 100 per cent. infection is often found in certain parts of the Gezira, a much less degree of infection is present in the same cotton at Shambat.

The disease is most widely spread in the Gezira Sakel cotton area, but occurs in many localities. At Shambat it is present in greatly varying amount in Sakellarides, Sea Island and American cottons, but not yet in Asiatic types. It has been reported from the plots of American cotton at Shendi and from other northern Pump Stations, but not from the American cotton sown in the Nuba Mountains, or Mongalla.* In 1929 it was found amongst Sakellarides cotton at Tokar. It has also been seen in small amounts in the new isolated cotton (Sakel) area at El Dueim. The disease is now prevalent on Sakel cotton in the Gash Delta, but the exact date of its introduction is unknown; its appearance on a large scale could not have occurred, however, before 1928.

GENERAL REMARKS.—The effect of an early infection on the general structure of the cotton plant appears to be a shortening of the petioles of the leaves, which form a more acute angle with the stem; a suppression of sympodia and monopodia, or alternately a slowing down of their growth, and a twisting of those already present.

In a field of cotton infected with the disease, elongated plants are occasionally observed with practically no lateral growth (monopodial or sympodial) in the upper parts. The general appearance of such plants suggests that a large amount of bud-shedding has occurred, causing tall and lanky growth. This malformation, however, is not a general symptom of the disease, and may be the effect produced by the virus on off-types, which occasionally occur in a cotton field.

In cotton sown about the middle of August the first signs of the disease usually appear towards the end of September, and from that date onwards the amount of infection increases with great variation in the degree of severity of the symptoms.

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* A specimen of typically infected cotton was received from Wau in the Bahr El Ghazal in 1926, but the diagnosis was not subsequently confirmed.—[R. E. M.]

SYMPTOMS OF THE DISEASE.

(1) *External.*—The most characteristic feature of the disease is the thickening of the veins of the leaf and bract, which may be so pronounced as to cause an upward curling of the leaves; these thickened regions are usually of a darker green than in the healthy plant. In badly affected cases outgrowths occur on the leaves in the form of circular cups or flat expanded areas over the veins. Cups have been seen measuring as much as half an inch in diameter, and in one instance the cups situated on the bracts were on short stalks. A spiral twisting of the petiole, peduncle, and the youngest parts of the stem is also common; while in severe cases buds are either totally suppressed or die shortly after formation, causing partial or complete sterility of the plant. Occasionally a definite mottling of the leaves is observed, but it is not yet certain that this is a symptom of Leaf Curl, for while mottling is not uncommon, more often infected plants show no mosaic symptoms whatever.

The infected leaves and stem become hard and brittle, so much so that the drooping and curling of the leaves and young stem due to water loss is less apparent in the infected parts than in the normal portions of the plants.

No case has been noticed of thickenings occurring on the boll-wall, even when the epicalyx and true calyx were severely affected, but curious corrugations and laminal outgrowths are often observed on the petals. Again, no case has been seen of the appearance of symptoms on the cotyledons; the first nodal leaf, however, can readily become infected and show definite symptoms of the disease.

The disease has been noticed in other Malvaceous plants, Bamea (*Hibiscus esculentus* L.), Til (*Hibiscus cannabinus* L.), and *Sida spinosa* L., which grow as weeds in the Sudan, and also in the garden hollyhock.

Only leaves that have not grown to their full size show the symptoms of the disease. By far the greater proportion of the plants first show the symptoms at the second or third leaf below the main growing point, and from this stage onwards the leaves are infected, occasionally in greatly varying amount, but more often with increasing severity as the plant develops.

Symptoms may first appear in the leaves near any growing point —*e.g.*, that of a monopodium or sympodium—but in by far the greater number of cases the first signs of disease are seen in the leaves near the main growing point. After the first symptoms have appeared, secondary growth from nodes below that of the infected leaf usually show the disease in increased severity, but on rare occasions normal leaves only are observed. On cutting back a plant, any secondary growth so induced is, in most cases, found to be more severely affected than before pruning.

It is concluded from the above that the progress of the disease is intimately associated with the growth of the plant; indeed, numerous experiments have shown that it is difficult to infect plants that are not in active growth, a characteristic typical of virus diseases. Occasionally it is noticed that in the second vegetative period (*i.e.*, after bolling) the new growth of infected plants is free from the symptoms; it is generally believed, however, that this is an exhibition of latency rather than that the plants are recovering from the disease.

(2) *Histological.*—Tissues which have suffered infection during active growth show striking changes. The principal effect is the stimulation of normal non-meristematic tissue to assume meristematic activity, leading to the production of various forms of tissue. Severe hypertrophy of the cells of the leaves, bract, and stem occurs, resulting in the malformations described above. This again is characteristic of many virus diseases. In the stem irregular bundles develop in the cortex with a formation of central xylem elements surrounded by a cambium and phloem. These bundles are mainly confined to the ribbed portion of the stem, but there are definite signs of meristematic activity in the whole of the cortical layer. In the infected petiole new vascular bundles may appear in the medulla.

An infected leaf is of a much thicker texture than a healthy one, and it is in the leaf that the formation of new growth is most evident. In the normal leaf a layer of palisade tissue is found evenly distributed on the upper surface of the leaf, except above the main vascular bundles, where normal parenchyma takes its place. In the infected leaf, however, there is no well-defined palisade layer, rectangular cells with large intercellular spaces occurring on both sides of the leaf which take the place of normal palisade tissue. A curious formation of similar cells is found also below the larger vascular bundles on the under surface of the leaf, giving rise to an abnormal amount of spongy tissue. Numerous conducting elements are formed in this spongy tissue, and generally there is in the whole of the leaf both externally and internally the appearance of confusion and growth without control. A search was made for the presence of cellular inclusions similar to those present in the tissue of the tobacco and potato leaves affected by mosaic. The method described by Likhité [4] was used, but no abnormal intercellular bodies were observed.

TRANSMISSION OF THE DISEASE.

Insect Transmission.—That this disease could be transmitted by insects in the Sudan was first shown by Kirkpatrick [3] who, working at the Gezira Research Farm, showed that an Aleurodid was the principal vector in the Gezira Area. Previous to this, Golding, [1] working in Nigeria, had shown that an Aleurodid was responsible for the spread of the disease in that country.

(*Grafting Experiments.*—The grafting of infected plants or buds on to a healthy stock is the only reliable method yet found for the artificial transmission of the disease. Infected buds were grafted on to healthy plants and the plant was then caged. Symptoms appeared in all the healthy stocks after four to eight weeks' growth, though the severity of the symptoms varied greatly. In no case did the infected bud develop, though there was definite union between it and the stock. In one plant the first appearance of the symptoms was in a shoot *below* the graft.

Artificial Inoculation of Healthy Plants.—No success was obtained in any experiment in which the expressed juice of infected plants was used as a medium of transmission. The following methods were tried:

(*a*) Infusions were made of crushed diseased tissue, old and young, fresh and dried, in distilled water, and the filtered extract injected into veins of healthy leaves by means of a very fine hypodermic syringe.

(*b*) The juice of diseased tissue was extracted by means of a powerful press and injected into the veins of healthy leaves.

(*c*) A watery extract of diseased tissue was sprayed on to healthy plants and poured round the roots.

(*d*) Healthy and diseased leaves were bruised together.

(*e*) Seeds from infected plants were ground, extracted with water, and the filtered extract injected as above. The injections were made in leaves, buds, and stems, and in one set of plants the juice was inserted by pushing very fine glass capillary tubes containing Leaf Curl juice into the tissue and leaving them *in situ.*

Six experiments were set up in which a healthy bud was grafted on to a healthy stock and juice from infected leaves was inserted between the bud and the stock. Union between bud and stock was definitely established in each instance, but no symptoms ever appeared in the stock. The bud developed in only one case, but it remained perfectly healthy.

In another set of experiments fourteen plants were injected with juice from infected leaves by making an incision in the stem, laying back the bark, and pouring the juice into the cortex, the bark then being tied up again; in every case a definite union was obtained again between the bark and the cortex, but no symptoms of disease ever appeared.

Seeds of a known pure line of Sea Island cotton were grown singly in pots containing pure sand—the pots being divided into groups of three, one pot of the group being watered with the normal culture solution, another with normal culture solution plus 5 c.c. per litre of expressed Leaf Curl juice, and the third with normal culture solution plus 5 c.c. per litre of juice from healthy plants, the object of the experiment being to decide if the juice of healthy or infected plants has any effect on the growth, and incidentally if the disease can be transmitted by the irrigation water passing over debris of diseased plants. No difference in growth was noticed, however, nor did symptoms of the disease appear on any of the leaves.

Seed Transmission.—To account for the appearance of isolated infected plants one would at first be led to suggest that some form of seed transmission occurs in nature. Seeds were collected from infected plants and sown in pots in an insect-free house; 639 plants were obtained, but no symptoms of Leaf Curl ever appeared. This does not definitely prove that seed transmission is impossible, but does suggest that if seed transmission is possible, then it can only be to a very slight degree. An acre of American cotton was sown on June 17, 1930; thirteen days afterwards—*i.e.*, eight days after its appearance above ground—a badly infected plant was noticed, severe symptoms being present on the first nodal leaf. This plant was situated towards the centre of the field, and no Aleurodids were seen in the plot; the plant was cut out, and no more Leaf Curl disease ever appeared in the plots. This is the only observed case that might be explained on a seed transmission theory.

Manurial Experiments.—A manurial experiment was laid out in the season 1929–30, to determine the effect of different manures on the yield of the cotton plant, the manures being given by the courtesy of the Imperial Chemical Industries, Ltd. A plot of 3 feddans in extent was laid out in a series of thirty randomized plots, being six replicates of five different manurial treatments.

Beds A	Ammonium sulphate.
„ B	Nitrochalk.
„ C	Ephos phosphate.
„ D	Ammonium sulphate+ephos phosphate.
„ E	Represented the control.

Observations of the incidence of Leaf Curl were made and resulted as follows:

LEAF CURL INFECTED PLANTS.

Beds.	*September.*	*October.*	*November.*	*December.*	*Total Plants.*
A	2	9	23	7	41
B	3	8	16	5	32
C	3	3	14	23	43
D	1	7	16	11	35
E	3	8	14	10	35
	12	35	83	56	186

This represented a percentage infection of 0·5 per cent.

The above table indicates that these different manures had no appreciable effect on the incidence of the disease—possibly the amount of infection was too small to bring out any difference. It is unfortunate that this experiment could not be repeated this year since the amount of disease in the general cotton has increased considerably.

EXAMINATION OF SEED COTTON.

A comparison was made between seed cotton from bolls with infected bracts and seed cotton from healthy plants, all growing in the same plot. The following particulars were taken on 100 seeds of each selected at random.

1. Weight of seed cotton.
2. Weight of lint.
3. Weight of 100 seeds.
4. Ginning out-turn.

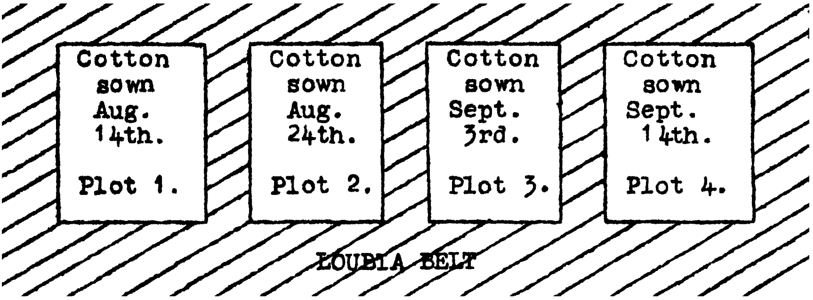
No appreciable difference was found in any of these characters, but it is hoped to repeat this on a larger scale.

THE EFFECT OF THE DISEASE ON THE YIELD OF THE COTTON PLANT.

General.—As mentioned above, a very severe attack of Leaf Curl disease on cotton causes sterility of the upper branches of the plant.

In order to determine the effect of the milder forms of the disease (such as occurs generally in a cotton field) four plots of cotton, each surrounded by a belt of a leguminous crop, loubia (*Dolichos lablab*), were sown at ten-day intervals. (See opposite.)

The loubia belts were sown on 4/8/30, the idea being to make each plot as far as possible a unit to ensure that there was a plentiful supply of Aleurodids in the plots. The plots were arranged in a row west to east, so that, since the prevailing winds are either north or south, no plot would act as an insect screen to the other.



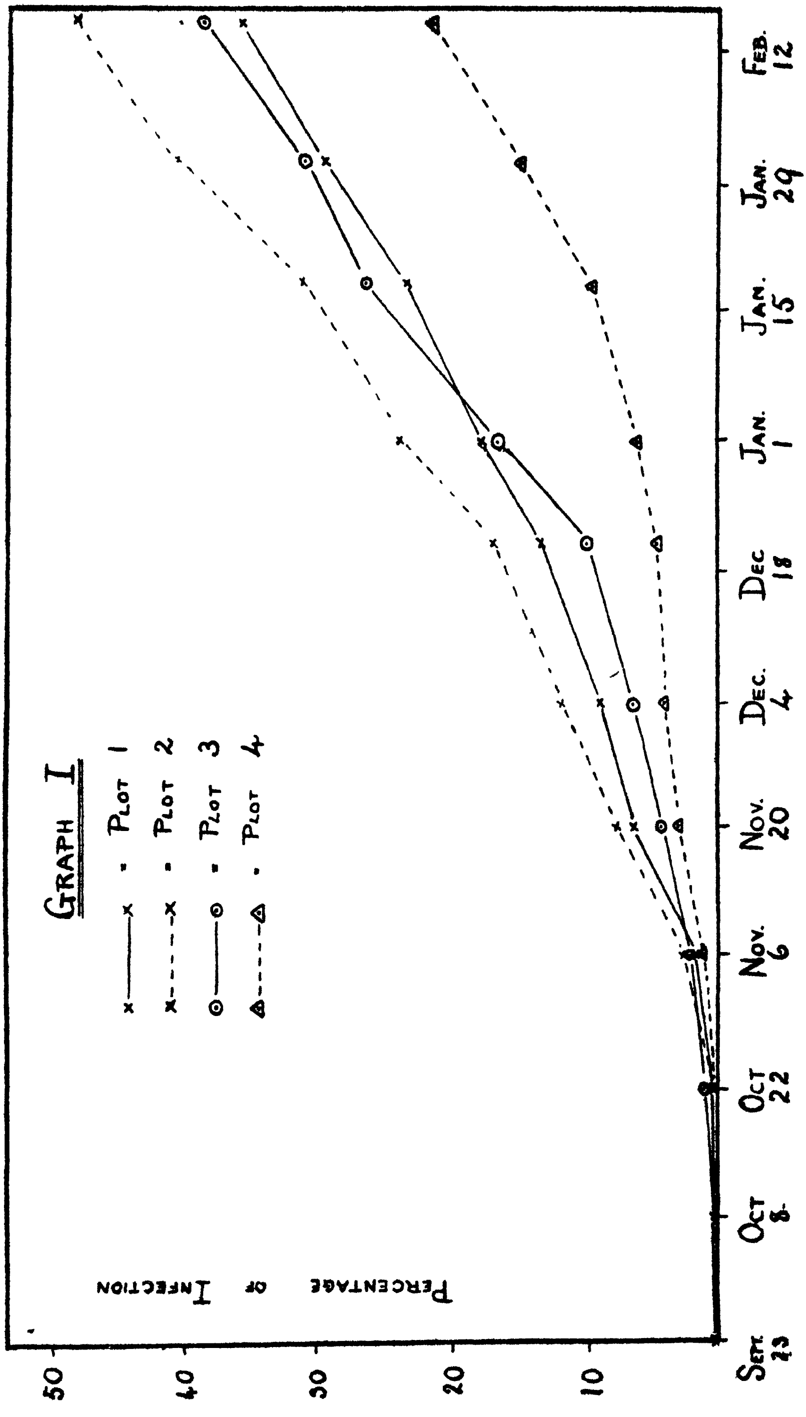
The cotton seed was picked over, diseased seed removed, and the remainder delinted by leaving it in concentrated sulphuric acid for fifteen minutes. After washing and drying, the seed was then sown, 6 to 8 seeds being placed in a hole; after one month's growth the seedlings were thinned to 2 plants per hole, each plot containing about 1,500 plants. The plots were watered by irrigation, at first after intervals of about nine days, but later every fourteen days. On 30/11/30 ammonium sulphate was applied to all the plots at a rate of 300 lbs. per acre. The first leaf curl infected plant appeared in plot 1 on 23/9/30—*i.e.*, forty days after sowing: from that date onwards the amount of the disease increased in all the plots. A count was made every two or three days of the number of new infected plants appearing in the plots, and Graph 1 represents the normal curve of percentage of disease in the plots.

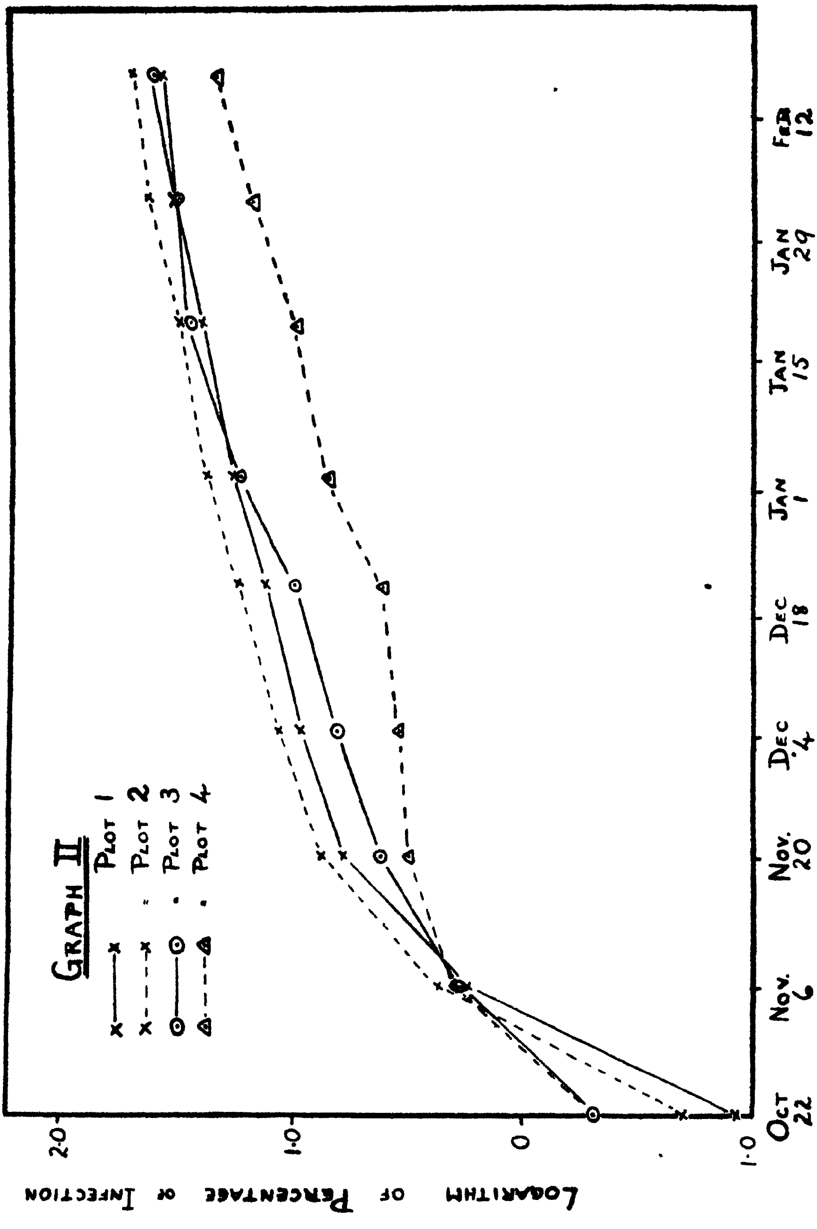
It will be noticed that the amount of disease is consistently greatest in plot 2. Whether this is solely due to sowing date or to some other cause it is impossible to say, but it indicates that the sowing date is a possible factor in determining the amount of disease in a plot. After November 20, the amount of infection appears to increase exponentially as shown in Graph 2—*i.e.*, the relative rate of spread of the disease is constant. Since this is so, it seems highly improbable that the disease can exist in the "suppressed form" (*i.e.*, without showing the symptoms), for an irregular rate of spread would be expected unless this "suppressed form" increased at a similar relatively constant rate.

Each plot was divided into four small plots of equal size, and the percentage of infection in each small plot was noted; no evidence could be found that the diseased plants were confined to any particular area.

The experiment was divided into two sections:

Section A.—Healthy and infected plants were matched and card diagrams were made of the subsequent growth of both healthy and infected plants. Out of 150 matched pairs originally obtained, by


Graph I
x——x = Plot 1
x- - -x = Plot 2
⊙——⊙ = Plot 3
△- - -△ = Plot 4
Percentage of Infection
50
40
30
20
10
Sept. 23
Oct 8
Oct 22
Nov. 6
Nov. 20
Dec. 4
Dec 18
Jan. 1
Jan. 15
Jan. 29
Feb. 12


GRAPH II
×——× Plot 1
×- - -× " Plot 2
⊙——⊙ " Plot 3
△- - -△ " Plot 4
Logarithm of Percentage of Infection
2·0
1·0
0
1·0
Oct 22
Nov. 6
Nov. 20
Dec 4
Dec 18
Jan 1
Jan 15
Jan 29
Feb 12

25/1/31 (the date when this part of the experiment was brought to a close) only 44 pairs were considered capable of true comparison owing to some of the healthy plants becoming diseased at a later stage, or to subsequent depredations of insects.

Section B.—Other infected plants in plots 2 and 3 were matched, using the same criteria as before, but no record was kept of their growth. On 11/12/30, in the case of plot 2, and 20/12/30 in plot 3, the plants were cut at ground level and each plant divided into four portions:

(1) Leaves.
(2) Stem=stem, petiole, growing point and bracts of green boll.
(3) Flowers=corolla, bract, and all unexpanded buds.
(4) Bolls=boll case without bracts.

The fresh weight of each portion was determined on each plant and the percentage loss on drying was calculated. Estimations of total nitrogen were made on portions (1) and (2) in each plant. The results of the experiment may be summarized as follows:

No difference was noticed in the following particulars between the means of the healthy and infected plants—

(*a*) Height.
(*b*) Number of nodes.
(*c*) Position of first primary leaf.
(*d*) Amount of shedding.
(*e*) Maturation period of the bolls.
(*f*) Number of seeds per lock.
(*g*) Percentage of nitrogen in the stem or leaves.
(*h*) Percentage loss on drying;

but a mean of the number of bolls per plant showed an excess in the healthy over the infected plant. The experiment, however, was not sufficiently critical to decide if the difference was due to actual sterility caused by disease or to very early bud-shedding: nor was it possible, owing to lack of staff and available land, to replicate the plots in order to obtain an accurate estimate of this deficiency of bolls, and consequent loss of crop.

As was stated above, the first infected leaf in the greater percentage of cases occurs at a node near the main growing point; it was found in this experiment that the position of the first infected leaf was comparatively constant, occurring at the second or third node below the main growing point.

THE EXPRESSED JUICE OF INFECTED LEAVES.

A striking difference is found between the colour of the juice expressed from the leaves of healthy cotton plants and that of infected plants—that from healthy leaves is of a red plum colour, while the juice from the Leaf Curl leaves is of a bright chlorophyll green, there being gradations in colour from red to green, according to the severity of the disease. On centrifuging, the juice from healthy leaves retains its original colour, while that from infected leaves is greenish-brown, with a heavy deposit of green matter which appears to consist mainly of chlorophyll. There appears to be much more chlorophyll in the diseased leaves than in the healthy ones. The juice in the living leaves of the healthy cotton plant is green, but on being expressed an unknown reaction occurs and the colour is changed to red; this reaction appears to be suppressed in leaves affected by this disease. On adding acid—*e.g.*, dilute hydrochloric acid—to the juice of infected leaves the normal red colour is obtained; and, again, alkali will change the red of healthy leaves to a green similar to that of the infected leaves. This, at first sight, suggests a difference in the pH value of the juices; a sample of each was, however, submitted to the Government Chemist, who obtained a value of 5·12 for the healthy plant and 5·18 for the Leaf Curl plant.

A chemical analysis of the expressed juice indicated a greater percentage of nitrogen in the Leaf Curl sample, calculated on the dry basis. A similar estimation of the reducing sugars gave a somewhat smaller percentage in the case of the Leaf Curl juice, but as enzyme action starts whenever tissues are crushed, too much significance cannot be placed on this result. On the advice of the Government Chemist a complete analysis of the dried and fresh healthy and infected leaves was undertaken, with the following results:

Residual Starch (on Fresh Leaves).—Plants were collected at dawn, and the leaves cut off and placed in boiling alcohol; no significant difference was observed between healthy and infected leaves.

Pentosans on oven-dried, sugar-extracted material again showed no significant difference.

Nitrogen.—No difference was observed in stem or leaves.

Diastatic Activity (Leaves).—This determination gave rather a surprising result: the figure obtained for the healthy leaves was 0·80, while a result of 2·92 was shown by the infected leaves.

Minerals.—On air-dried leaves:

	Gezira.	
	Healthy (*September*).	*Diseased* (*November*).
Nitrogen	4·460	3·860
Phosphate	0·870	0·880
Silica	0·940	0·530
Lime	4·680	3·610
Sulphur	1·420	1·480
Iron Oxide	0·310	0·310
Manganese	0·021	0·026
Magnesia	0·730	0·980
Potash	3·040	3·750
Soda	0·070	0·020

GENERAL.

Though the disease is found in American types of cotton, it has never been reported as occurring outside Africa, and while in the Sudan it appears that Sakel type cotton is the most susceptible, it has so far not been reported as occurring in Egypt—the home of Sakel cotton; nor is this due to the use of a resistant type, for Giza 7 grown at Shambat with a view to testing its reaction to the disease was found to be highly susceptible. It is possible that the distribution of the insect vector and a totally different time of sowing may be an explanation of this.

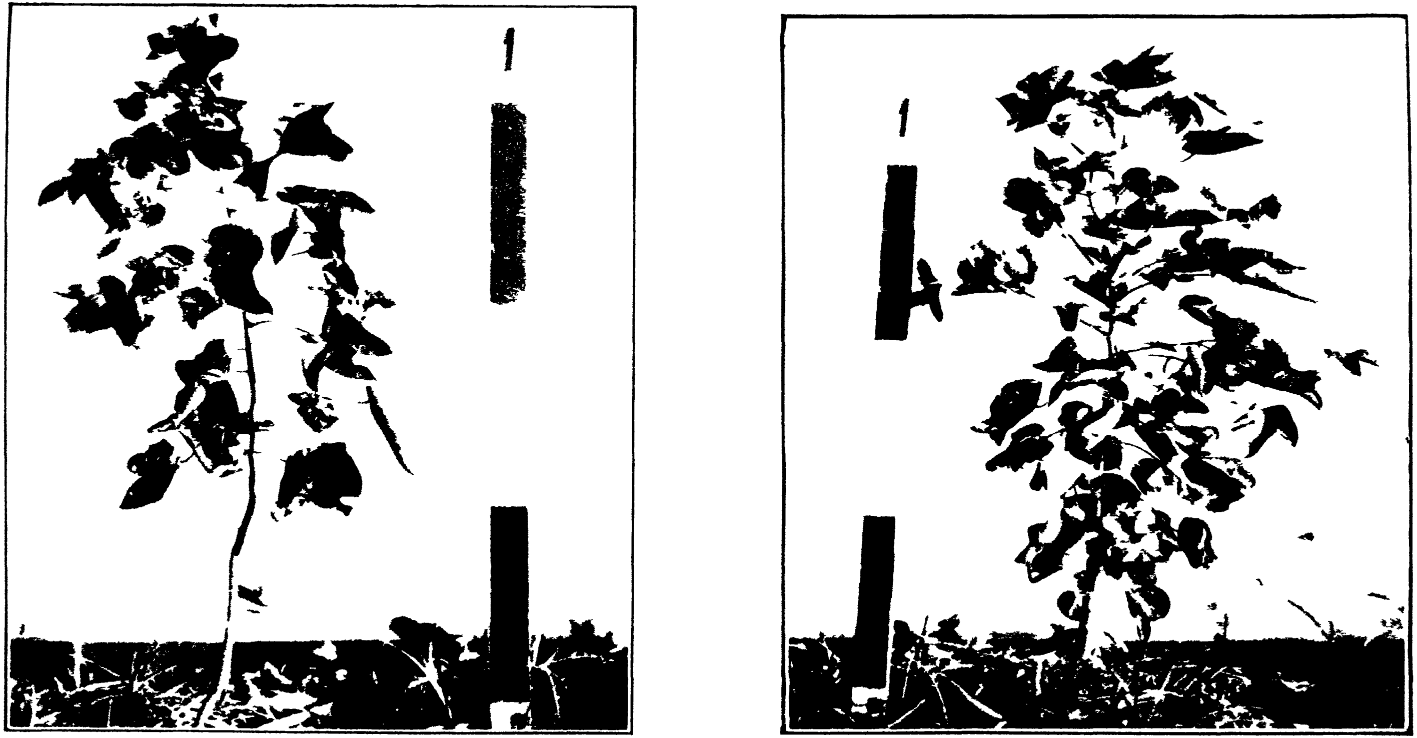
There is no evidence yet that soil plays any great part in the incidence of this disease except in so far as the growth of the plant is affected, for active growth is necessary for full development of the symptoms.

The virus appears to be able to travel equally well up and down the stem, for plants showing signs of disease near the main growing point, on being cut back, develop diseased secondary growth along the whole length of the stem. Again, on making bud grafts on the lower part of the stem of a healthy plant, diseased leaves appear along the entire length of the stem. There appears to be some evidence that the effects of the virus spread out from the vascular system, for the thickening of the tissue is usually greatest at the vascular bundle, and becomes less noticeable with increasing distance.

SUMMARY.

1. The distribution of Leaf Curl in the Sudan is indicated.
2. The symptoms of the disease, both external and internal, are described.
3. The insect vector of the disease appears to be an Aleurodid, and no success was obtained by inoculation with the juice of infected plants.
4. Experiments with grafting, which seems to be the only successful method of artificial transmission of the disease, are described.
5. The question of transmission via the seed, and the effect of manures on the development of the disease amongst the crop, are discussed.
6. The effect of the disease on the yield of cotton is examined.
7. Chemical analyses of diseased and healthy cotton plants are recorded.

PLATE I

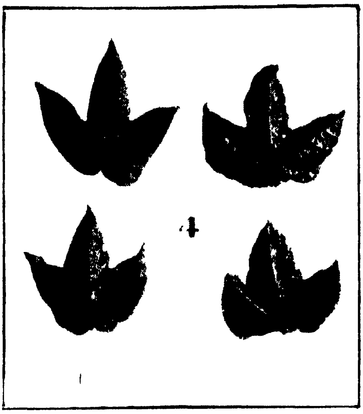


INFECTED PLANT

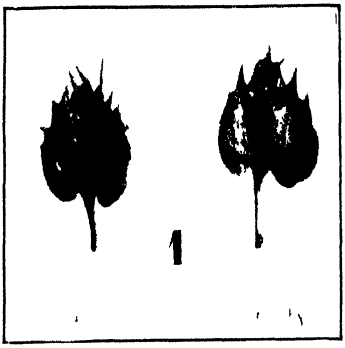
HEALTHY PLANT

Showing typical effect of the disease on cotton plants in the field

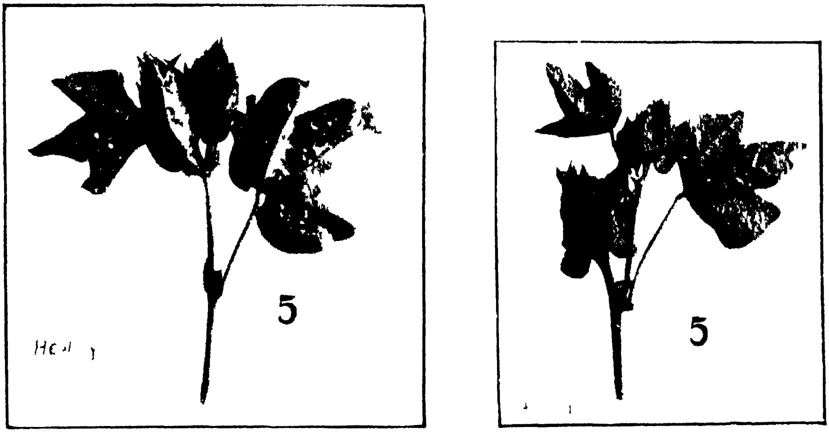
PLATE II.



(1) A Comparison of Healthy and Infected Leaves

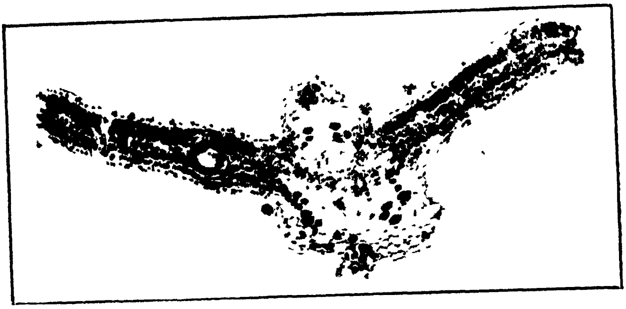


A Comparison of Healthy and Infected Bracts

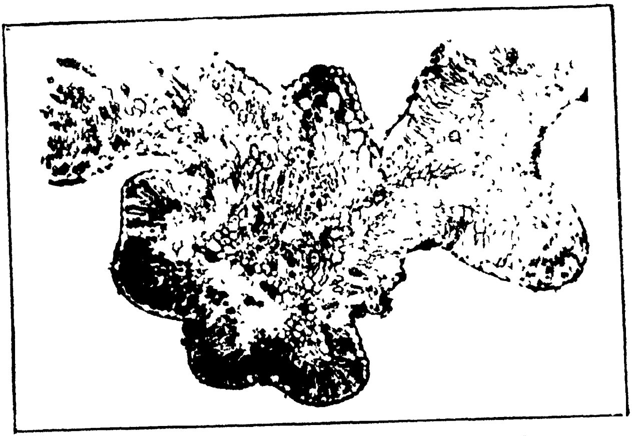


(2) Showing Effect of Disease on Sympodia, with Reduction in the Size of the Buds

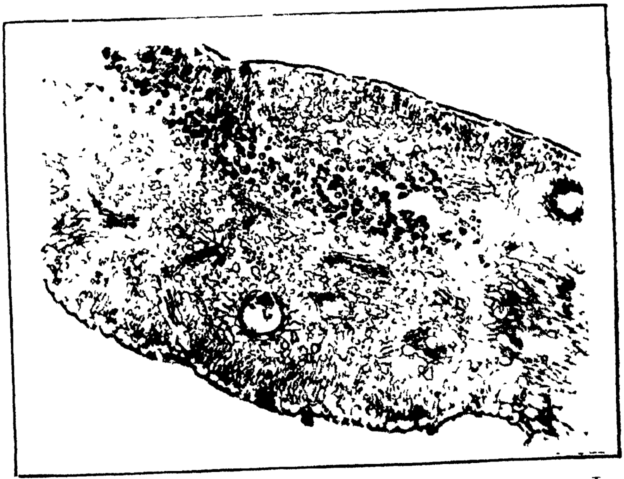
PLATE III.



(*a*) T.S. of Healthy Leaf.



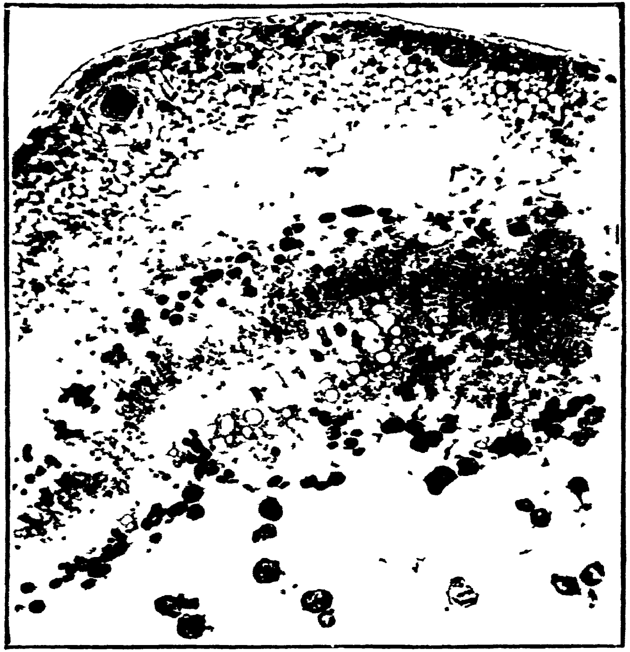
(*b*) T.S. of a Principal Vein of Infected Leaf.



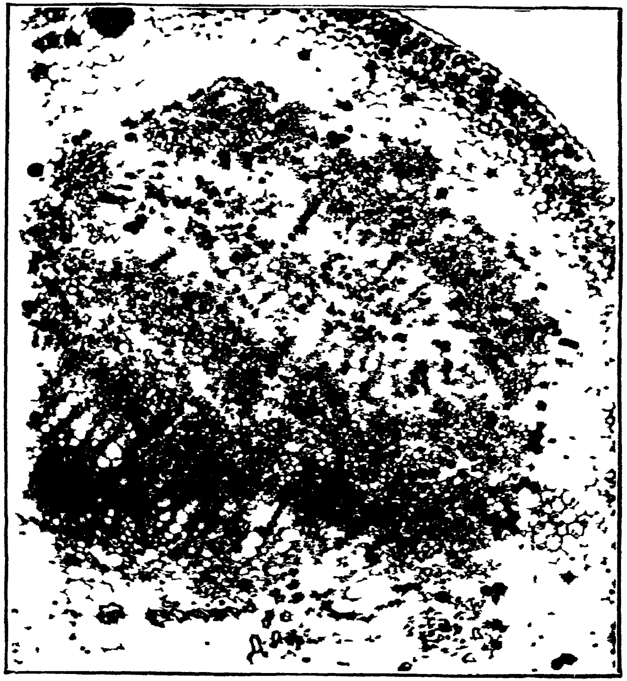
(c) T.S. of a Portion of Thickened Lamina of Infected Leaf.

All these photographs are of the same magnification.

PLATE IV



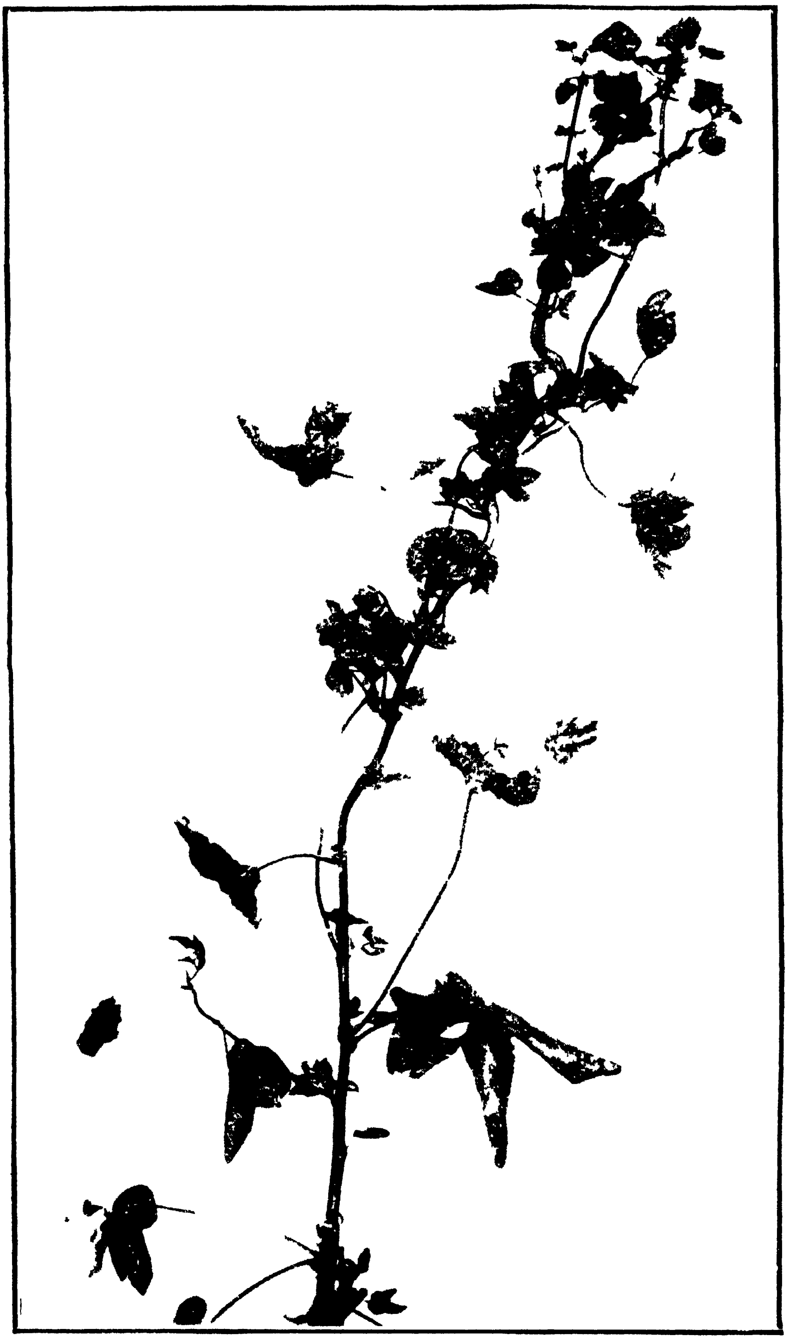
(*a*) T.S. OF HEALTHY STEM



(*b*) T.S. OF INFECTED STEM SHOWING DEVELOPMENT OF IRREGULAR VASCULAR BUNDLES IN THE CORTEX

Both photographs are of the same magnification

PLATE V.



Upper Portion of Badly Infected Plant showing Characteristic Bending and Twisting of the Stem, Cupping of the Leaves and Complete Sterility of Upper Branches

PLATE VI

INFECTION TRANSMITTED BY GRAFTING AN INFECTED BUD ON TO A HEALTHY STOCK.

ACKNOWLEDGMENTS.

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LITERATURE CITED

[1] GOLDING, F. D. " A Vector of Leaf Curl of Cotton in Southern Nigeria." EMPIRE COTTON GROWING REVIEW, vol. vii., No. 2, April, 1930.

[2] JONES, G. H., and MASON, T. G. " Two Obscure Diseases of Cotton." *Ann. Bot.*, vol. xl., No. 140, October, 1926, p. 759.

[3] KIRKPATRICK, T. W. " A Preliminary Note on Leaf Crinkle of Cotton in the Gezira Area, Sudan." *Bull. Entomological Research*, vol. xxi., p. 2, July, 1930.

[4] LIKHITÉ, V. " The Nature and Relations of the Intracellular Inclusions present in the Mosaic of Tobacco." *Rev. App. Mycol.*, vol. viii., No. 10, p. 611 (abstract).

EXPLANATION OF PLATES

Plate 1.—A comparison of healthy and diseased plants growing in the field. Note the almost complete absence of bolls in the infected plants. Both plants are of the same age.

Plate 2.—(1) A comparison of infected and healthy leaves and bracts.

(2) A comparison of infected and healthy sympodia, showing the reduction in size of the diseased buds and the curling of the bracts.

The perforations in the leaves of the healthy sympodium are due to insect attack.

Plate 3.—Transverse sections of the lamina and veins of healthy and infected leaves. Note the hypertrophy of the cells, and the absence of a definite palisade layer in the diseased lamina.

(*a*) T.S. of healthy leaf.
(*b*) T.S. of a principal vein of infected leaf.
(*c*) T.S. of lamina of infected leaf.

These sections are all of the same magnification.

Plate 4.—Transverse sections of the stems of healthy and infected plants.

(*a*) T.S. of healthy stem.
(*b*) T.S. of infected stem. Note the development of new bundles in the cortex.

Plate 5.—Upper portion of a badly infected plant, showing characteristic bending and twisting of the stem, curling of the leaves, and complete sterility of the upper branches.

Plate 6.—Showing infection transmitted by grafting an infected bud on to a healthy stock.

Received October, 1931.

CLASSIFICATION OF THE WORLD'S COTTON CROPS

BY

JOHN A. TODD, M.A., B.L.

THE history of the cotton trade contains many records of the substitution of one variety of cotton for another, due to changing conditions both of supply and demand. At the beginning of the nineteenth century the new American crop was rapidly driving out the older crops from the West Indies, Central America, and Brazil, as well as from the Levant and India, crops which had formerly supplied the bulk of the raw material for the rising Lancashire industry. During the Civil War the American crop in turn suffered a temporary eclipse, as the result of which Egyptian cotton acquired a footing in Lancashire which proved to be permanent. Since the beginning of the present century the world has lost the major part of the Sea Island supply from the Atlantic States, but its place has been taken by Egyptian Sakel in a way that would hardly have been thought possible. Now, during the season 1930-31, Outside Growths as a whole have taken the place of American to such an extent that for the first time in modern history the world's consumption of American cotton is less than that of its various rivals.

Substitution is mainly a question of price, or rather of getting the best value for the money, and as the spinning value of any cotton mainly depends on its staple length, it is of interest now to attempt a classification of as many as possible of the world's cottons according to staple length. Such a classification was first attempted by the writer in 1914,* but many things have happened since then. In those days the different cotton crops—*e.g.*, Egyptian, American, Indian—were all more or less in watertight compartments, their markets being fairly sharply separated from each other. Today the classification is much less distinct. All these main varieties now require to be subdivided, and there are a great many other crops, some of them small but others very substantial, which require to be set in their proper place in the scale of values. Owing to the number and variety of these new crops a broad classification of the world's cottons into separate compartments is no longer possible, for some of them will at times compete with a variety just a little above them, while at other times, owing to a change in price conditions, they may find their best market in competition with another variety a little below them. Thus the classification nowadays, instead of being a series of three or four broad plateaux definitely separated from each other, is rather a gradual decline from the highest to the lowest with intermediate steps all the way down. Yet a broad classification is still worth attempting, with the necessary reservations, if for no other reason than to show the changes which have taken place in recent years.

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* *The World's Cotton Crops*, 1915, p. 17.

Thus, in the writer's first attempt at classification seventeen years ago, he divided the world's crops into five grades as follows:

I. Best Sea Island, from the Carolinas and the West Indies.
II. Florida and Georgia Sea Island, with the best varieties of Egyptian.
III. The bulk of the Egyptian crop, with the long staple American Upland varieties and Peruvian.
IV. American, forming the bulk of the world's supplies, supplemented by Brazilian and the new crops from Africa, Russia, etc.
V. Indian and Chinese, with other smaller crops of similar short staple.

With the disappearance of the whole of the American Sea Island crop, and the change in the Egyptian crop through the rise of Sakel at the expense of Brown (Affifi), it seemed simpler to slump the whole of the first three of these grades into one, and the classification thus came into three grades which were fairly described as Fine, Medium, and Short staple cotton.* But with the latest developments, it has become necessary again to recast the classification, because the Egyptian crop, for example, is now pretty sharply divided between Sakel and Uppers, with quite different markets. At the same time, owing to the deterioration of the American crop, quite a substantial part of it is now very little better than some of the Indian crop, while, on the other hand, the development of longer stapled varieties in India has raised a material portion of that crop sufficiently to make it comparable with American. The Russian crop also has shown a very marked improvement.

In the new Table of Classification which is given on page 52, the writer has therefore attempted a new classification into four Groups, and as the old nomenclature of Fine, Medium, and Short staple is no longer adequate, he has adopted instead a classification definitely by length of staple. This, of course, has raised many difficulties, first of all in drawing the line between the different staple groups. For the best grade he has chosen *Above* 1⅜ *in.* as the definition, so as to include only Sea Island and the best Egyptian varieties. The second group, *Above* 1⅛ *in.*, consists largely of Upper Egyptian with other varieties which definitely compete with it. The third group, ⅞ *to* 1⅛ *in.*, is still, as always, the largest, but it now includes a much larger number of different crops, many of which have to be divided between this group and the one above or below it. Finally, the fourth group—*Under* ⅞ *in.*—now includes part of the American crop, as well as the bulk of the Indian crop and most of the other Asiatic varieties.

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* *The Cotton World*, 1927, p. 5.

Again, in making a classification by staple it has to be kept in view that the official description of staple length does not always correspond with the ordinary trade valuation, particularly in the case of the official standards for the American crop, for the official measurements of staple length in America have always been much more exacting than the trade descriptions, say, in Liverpool. Thus, staple Upland cotton which in America would be described as 1⅛ in., would probably pass muster in Liverpool as at least $1\frac{3}{16}$ in., and this will be found to explain some apparent discrepancies between the classification we have adopted and the official figures of the American crop. Some of these points will be brought out more fully in the following detailed comments on our Table. It will, of course, be noted that in the Table the amount of each crop is stated first in bales, or in the case of Egyptian in kantars, but in order to get rid of the complication of the varying bale weights all the figures have been converted into thousands of pounds. The figures given are for the season 1930-31.

Group I., Above 1⅜ *in.*—This group still covers two types which only compete at the margin. Thus the best Sea Island cotton from a few of the West Indian Islands—*e.g.*, St. Vincent and St. Kitts—is still a long way above even the best Egyptian Sakel, but the ordinary run of Sea Island, such as Montserrat, is not so far above the best Sakel, and Porto Rico and Fiji Sea Island probably still less so. Again, the Fiji crop is not all Sea Island, and the same applies to the crop from the other West Indian Islands, a considerable proportion of which is Marie Galante, and hardly deserves to be included in this group at all. Finally, it is worth noting that there is still a very small quantity of Sea Island cotton grown in the Atlantic States, and last year it actually increased from 7 to 20 bales!

But for the great majority of their products the fine spinners of the world now use Egyptian in place of Sea Island, and as a matter of fact many articles which are sold as Sea Island are really made from Sakel. Sudan Sakel for a time threatened the Egyptian variety with very serious competition until last year, when the serious failure of the Sudan crop, which affected not only its quantity but also its quality, almost put Sudan Sakel out of the running. The Arizona crop of Pima cotton, bred originally from Egyptian sources, is a relatively small factor in the supply of Egyptian. Incidentally its descendant in Egypt, Maarad, is included in our estimate for Egyptian Sakel.

Group II., Above 1⅛ *in.*—The classification of Pilion and Nahda with Ashmouni and Zagora may cause some surprise, but it is in accordance with the Egyptian Government's latest classification of their crop into Long, Medium, and Short staple. The Brazilian crop provides the first illustration of the difficulty of dividing one crop into two classes where it is very difficult to get any statistics. The varieties grown in Northern Brazil, which are roughly of the native American types akin to Barbadense, are definitely of longer staple than the Southern Brazil types from Sao Paulo, etc., which are known to be of purely American origin. The actual allocation of the amount of the total crop between these two is, however, largely a matter of guesswork, but we have founded our guess on a paper* recently published by Dr. W. W. Fetrow, Senior Agricultural Economist of the Division of Cotton Marketing in the Bureau of Agricultural Economics at Washington. As to the Peruvian crop, according to Dr. Fetrow some of it should come into the third group, but it is a very small proportion. Haiti cotton presents a difficulty because some of it is reported to be of Sea Island quality, but the bulk is certainly not of that grade, and indeed it is doubtful whether it really should fall into the present group at all.

The staple Upland crop of the United States includes both the survivors (or successors) of the old long staple crops in the Mississippi Valley, and also the improved varieties such as Webber in South Carolina and in small areas in Texas and other States. The figure we have taken for the total of these supplies is the U.S. official figure of "1⅛ in. and above," in their returns for the 1930 crop. This might seem to be erring on the high side, but as a matter of fact private estimates of the Mississippi Delta crop alone in recent years have been substantially higher than that figure.

Of the British Empire crops in East Africa, the bulk of the Uganda and Tanganyika crops come within this grade; possibly also some small part of the other African crops should come in this group—*e.g.*, Eritrea—but it is impossible to get any definite information.

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* Reproduced in the *International Cotton Bulletin*, January, 1931.

Group III., ⅞ to 1⅛ in.—The allocation of the American crop between this grade and those above and below it is founded on the official returns of grade and staple for the 1930 crop, but here again there is some doubt as to the exact definition of the staple. Probably a good deal of what they describe as "under ⅞ in." would pass muster in Liverpool as ⅞ in. or a little above. As to all the other crops included in this group there is a considerable amount of doubt. Some of the South American crops—*e.g.*, Argentine—contain a proportion of cotton which might be classed as above 1⅛ in. Again, the proportion of the China crop which is above ⅞ in. is very largely guesswork, but our guess is based roughly on Dr. Fetrow's figures. On the strength of a statement by the Russian authorities, we have included the whole of the Russian crop in this group, but that is a very great change from say ten years ago, when a large proportion of the crop was of the short staple Indian varieties, and it is difficult to believe that these have now been entirely eliminated. Again, in India the Government figures of allocation between ⅞ in. staple and above and the shorter stapled varieties certainly require some modification, and our figure is partly a guess.

Group IV., Under ⅞ in.—Various uncertainties with regard to the items in this group have already been indicated, and to this may be added the allocation of the Asia Minor crop between Groups III. and IV. Before the War the Germans had introduced American varieties into Adana and Aidin, but it is not known how much of this has survived. In Korea also there is some doubt whether the whole crop should be included in this group, for a good deal of work has been done in the past in the development of American varieties there, but no definite information is available as to the proportion of these varieties in the total crop.

Looking now at the result of the whole Table, the summary on the next page compares the percentages of the different groups with the corresponding figures in previous attempts at classification. This appears to show that the percentage of cotton better than the ordinary run of American has steadily increased.

Finally, it remains to be noted that our new Classification Table is for the season 1930-31, but it is already clear that in the new season the figures will be very substantially changed by the extraordinary "come-back" of the American crop this year. The total crop has increased from less than 14 million bales to nearly 17 millions. As to the grade and staple of the crop no details are yet available, but it is evident from the early reports that the deterioration which has marked the last three years has this year been completely reversed, and that the staple of the whole crop has been increased by probably a sixteenth of an inch. Thus the allocation of the crop between Groups III. and IV. this year will obviously be something quite different from last year. Again, the relative quantities of Sakel and Uppers in Egypt in 1931 will require drastic revision; all of which only serves to emphasize the danger of regarding any such classification as permanent.

1930-31			1925-26			1913-14		
Group.	*Lbs.*	*% of Total.*	*Group.*	*Bales.*	*% of Total.*	*Group.*	*Bales.*	*% of Total.*
	000's			000's			000's	
I.	285,659	2·3				I.	15	0·1
			I.	2,644	9·2	II.	500	1·9
II.	1,125,500	9·1				III.	1,325	5·0
III.	7,499,312	60·4	II.	19,210	67·0	IV.	16,460	62·6
IV.	3,500,550	28·2	III.	6,810	23·8	V.	8,000	30·4
	12,411,021			28,664			26,300	

NOTE.—The writer would welcome criticism or further information on any of the detailed points above referred to or raised by the Table overleaf.

CLASSIFICATION OF THE WORLD'S COTTON CROPS, 1930-31.

Group and Staple.	*Variety.*	*Where Grown.*	*Bales.*	*Weight. Approx. Lbs.*	*Lbs. 000's*
I.: Above 1⅜ in.	Sea Island	British West Indies	5,000	400	2,000
		Porto Rico	3,500	500	1,750
		U.S.A.	20	480	10
		Fiji	400	400	160
	Egyptian: Sakel, Maarad, etc.	Egypt	*2,320,830	100	232,083
	Sakel	Sudan	* 400,000	95	38,000
	Pima	Arizona	23,312	500	11,656
		Total	..	..	285,659
		Percentage of Total ..	..	..	2·3
II.: Above 1⅛ in.	Pilion, Nahda, Ashmuni, etc.	Egypt	*5,700,000	100	570,000
	Brazilian	Brazil N.	300,000	500	150,000
	Peruvian	Peru	200,000	500	100,000
		Haiti	22,500	500	11,250
	Staple American	Mississippi Delta, outh Carolina, etc	444,500	500	222,250
		Uganda and Tanganyika	180,000	400	72,000
		Total	..	..	1,125,500
		Percentage of Total ..	..	..	9·1
⅞ to 1⅛ in.	American	U.S.A.	11,452,400	478	5,474,247
		Mexico	169,000	500	84,500
		Central and South America	64,000	500	32,000
		Brazil	200,000	500	100,000
		Argentine	135,000	500	67,500
		Sudan	115,000	91	10,465
		East and South Africa	50,000	400	20,000
		Nigeria	25,000	400	10,000
		Africa, Non-British	100,000	500	50,000
		Australia	10,000	400	4,000
		Iraq	4,000	400	1,600
		Russia	1,750,000	500	875,000
		Europe and Asia Minor	100,000	500	50,000
		China	400,000	500	200,000
	Indian 1/s.	India	1,300,000	400	520,000
		Total	..	..	7,499,312
		Percentage of Total ..	..	..	60·4
Under ⅞ in.	American Indian, etc.	U.S.A.	1,834,100	500	917,050
		India	3,500,000	400	1,400,000
		Korea, etc.	150,000	500	75,000
		East Indies	13,000	500	6,500
		China	2,000,000	500	1,000,000
		Persia	124,000	500	62,000
		Asia Minor	80,000	500	40,000
		Total	..	..	3,500,550
		Percentage of Total ..	..	..	28·2
		Grand Total	..	..	12,411,021

* Kantars.

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EMPIRE COTTON DURING THE COTTON FAMINE OF 1861-1864

BY

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In view of the efforts now being made to increase the supply of Empire cotton, it is interesting to recall that during the cotton famine of the early sixties, caused by the American Civil War—the one occasion on which supplies from the Southern United States failed almost completely—it was from sources within the Empire that Lancashire obtained a large proportion of the diminished supplies with which she had then to be content. In 1861 it was still possible to secure a considerable amount of cotton from America (1,841,600 bales), but in the whole of the subsequent three years only 401,466 bales came from this source. In those years India alone supplied Great Britain with just over 70 per cent. of the cotton she imported.[3]

The danger of the dependence of the Lancashire cotton industry upon a single source of supply for the bulk of its raw material—80 per cent. of its total imports of raw cotton in 1860 came from the Southern States—had been recognized only by the more far-sighted of public men and Lancashire merchants. John Bright, however, had secured the appointment of a Select Committee on the Growth of Cotton in India, which had published its report in July, 1848. Later, in conjunction with two cotton manufacturers—T. Bazley and H. Ashworth—he raised a subscription to enable Alexander Mackay to be sent to India to make enquiries into the possibility of increasing cotton supplies from that country. Mackay died on the way home, but his reports were published in 1853. A further step was taken in 1857, when the Manchester Cotton Supply Association was formed to widen the sources of Lancashire's cotton supply by distributing cotton seed and gins, by circulating instructions on methods of cotton farming, and by sending agents to encourage cotton growing.

All but a fraction of the cotton produced in the Empire came from India, where cotton had been grown from the earliest times, though to what extent is not known. The chief Indian cotton districts were the Punjab and Sind in the North West, Oude and the Doab in the North East, Guzerat on the West coast, the Deccan, Sholapor and Dharwar in Central India, and Coimbatore and Tinnevelly in the South.* Cotton was transported to Bombay by carts, by river boats, and by coasting vessels, and was then sent to England or China.†

Cotton was not grown in India by the same methods as in the Southern States. In America it was a staple product grown on large estates by slave labour, but in India it was raised on small holdings and was a small subordinate crop sown only every third or fourth year. The ryot's main occupation was to raise enough food for the coming year. He would "not neglect the raising of food for the sake of cotton, however high its price may be, for in so doing he runs the risk of starvation" ([19] p. 13). Neither the yield nor the quality of Indian cotton equalled that of the Southern States. English and American planters, both private individuals and civil servants, had conducted experiments to improve methods of cultivating cotton and to increase the yield per acre, but their efforts had met with only partial success. Indian cotton was, to a considerable extent, used locally: it was cleaned by the primitive churka, and skilfully spun with astonishing fineness of touch on a simple loom by the village weaver. It was used not only for clothes but for pillow stuffings, quilts, ropes, sails, carpets, towels and tablecloths.

The inability of India, despite her apparently great potentialities in cotton-growing, to supply England regularly with a large quantity of good cotton, was due to various causes. The climate was not so suitable as in the Southern States. Cultivation was hampered by the persistence of old-fashioned and traditional methods, due largely to "the very low and abject condition of the cultivators of the soil, the absence of capital and the extent of the Government demand for rent or revenue," which were brought to the notice of Bright's Committee.[5] Further, trade was hampered by lack of a law of contract and of a bankruptcy act, and also by the fact that no energetic steps were taken to stop the adulteration of cotton. Above all, Government failed to provide proper roads and bridges: Mackay stated that in

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* Rivett Carnac ([9], p. 22) estimated in 1868 that "the total of the cotton cultivation (area) throughout . . . India does not exceed 8½ million acres," and that the number of bales exported annually to England was about 1,700,000.

† Table (constructed from [10], p. 61), showing destination of Indian Cotton:

	Great Britain (Million Lbs.)	*China (Million Lbs.)*	*Elsewhere (Million Lbs.)*	*Total (Million Lbs.)*
1835–1839	51	85		**136**
1840–1844	88	86		**174**
1845–1849	70½	82	4½	**157**
1850–1854	130½	84¼	6¼	**221**
1855–1858	185	43	19	**247**

Guzerat there were no roads " in the civilized and ordinary sense of the term,"[17] and it was reported from Indore that it took longer " to convey the cotton to port than to rear the plant."[8] An economic factor of importance was " the irregularity of the prices and the irregularity of the demand for Indian cotton." ([19] p. 25). The Lancashire merchant took Indian cotton only when he could not obtain American, and in China political unrest restricted trade.

At the time of the cotton famine several companies were formed to obtain supplies from India. The most important was the Manchester Cotton Company, which undertook cotton growing in the Dharwar district near the new port of Sodashegur, where, however, there were difficulties with the construction of a pier, and of a road from the port to the cotton district, and in the spring of 1862 neither road nor pier had been built. These difficulties, coupled with the lack of native labour and the unhealthiness of Sedashegur, caused the Manchester Cotton Company to go into liquidation in 1864.

A problem which faced those who endeavoured to extend cotton culture in India was the difficulty of buying waste lands. Lord Canning's simple plan for their disposal was replaced by the far more complicated scheme of Sir Charles Wood, with the result that much of the land remained uncultivated. The attitude of the Government on these questions met with much criticism in some quarters. Imports of cotton from India, however, increased from 563,000 bales in 1860 to 1,390,000 in 1863, and 1,866,610 in 1866. The quality was poor: it was said that " the sudden rise in price in the middle of the year 1862 has . . . caused all the sweepings and refuse of the bazaars to be sent to the ports for shipment."[14]

After India the most important sources of Empire cotton were the British West Indies and British Guiana. In 1786-9 the British West Indies had sent England 45,000 bales or 70 per cent. of England's total cotton imports. In 1805, when it was taken over from the Dutch, British Guiana was " a cotton rather than a sugar producing country."[7] In the nineteenth century, however, supplies declined from both colonies owing to the scarcity of labour and to the fact that the price of cotton declined more rapidly than that of sugar. Thus in 1826-30 the British West Indies sent only 12,940 bales, or 2 per cent. of England's cotton imports, and in British Guiana the culture of cotton almost ceased. During the cotton famine it was hoped to revive cotton culture in these colonies. In the British West Indies attention was turned chiefly to Jamaica. Companies such as the Jamaica Cotton Company were formed, and some progress was made. Cotton was also grown in the Bahamas, Trinidad and the

Barbados. In British Guiana the growing of cotton was strongly urged by Sir W. H. Holmes, but few supplies seem to have been obtained from this source.

Elsewhere the growing of Empire cotton was only in the experimental stage. In Natal cotton grew wild, but the natives failed to use it. An early attempt in 1847-9 by a Natal Cotton Growing Company to grow cotton on a large scale had failed. The Cotton Plantation of Natal Company was formed in 1862, and at about the same time the Government tried to get over the labour difficulty by introducing Indian coolies. In the Cape of Good Hope the Albany Agricultural Society did its best to encourage the cultivation of cotton.

In Australia cotton had been grown experimentally as early as 1807 in New South Wales, and later in Victoria. The first export of cotton took place from Sydney in 1832. But it was Queensland which interested England most as a possible source of supply. J. D. Lang had written a book in 1847 to advocate emigration to this "future cotton field of Great Britain," and successful experiments had been made in 1857-8. The chief difficulties were the distance from England, the fact that most of the capital of the colony was already invested in wool, and the lack of cheap labour. Some hoped to solve the labour problem by introducing Chinese and Indian coolies, and the Governor of Queensland stated that "no impediment will be thrown in the way of individuals or companies desirous of procuring Asiatic labour at their own cost."[1] The Queensland Government gave prospective cotton-growers land on easy terms, and offered bonuses for cotton raised by them. Companies were formed at home and in the colony to trade in Queensland cotton, one of the most important being the Queensland Cotton Company with a capital of £50,000. Over 3,000 persons went to Queensland in 1861, and it was said that many of them contemplated cotton growing. Despite all encouragement, cotton culture was not successfully established at this time in Queensland—partly because of exceptionally bad weather and floods—and some companies and private individuals suffered heavy losses.

Empire supplies of cotton, though naturally very welcome in the period of the cotton famine, were not so extensive as had been hoped. No conscious attempt seems to have been made either by the Government or by merchants to encourage Empire cotton rather than any other kind of cotton. Indeed, Lancashire merchants, with a few exceptions, showed astonishingly little interest in the question of cotton supplies until the crisis had become acute. When the need was appreciated merchants consoled themselves with the facile hope that cotton could be grown in any tropical or semi-tropical country, and the most extravagant hopes were entertained of the most unlikely sources of supply. No sufficient distinction was made between places like India, Egypt,* Brazil and the West Indies, from which supplies could be immediately increased if capital to improve means of transport and methods of cleaning and packing and to secure labour were forthcoming, and places like West Africa and Australia, where no appreciable increase could reasonably be expected for many years. Nor was sufficient distinction made between those measures which would ultimately increase the permanent supply of cotton and those which might temporarily increase that supply to meet the urgent situation of 1861-4.

It may be observed, in conclusion, that the cotton famine, though a very important cause, was not (as has sometimes been supposed) the sole cause of the cotton crisis of the early sixties. An abundant supply of cheap cotton—due to big harvests in the Southern States—coupled with unexpectedly heavy Far Eastern demands for cotton goods, had led to considerable overproduction in Lancashire in 1859-60, which would, in all probability, have resulted in a crisis whether there had been a cotton famine or not.

SELECT BIBLIOGRAPHY

GENERAL: [1] *Cotton Supply Reporter*, August 1, 1864; [2] *do.*, August 15, 1861; [3] T. Ellison, "Cotton Trade of Great Britain" (London, 1886), Table I. in Appendix; [4] "Annual Reports of Cotton Supply Association"; [5] Parliamentary Papers, 1847-8, IX., Report v.; [6] do., xi., qu. 4304; [7] do., 1850, XLII., 492; [8] do., 1857, XXXI., Part I., p. 13; [9] do., 1868-9, XLVI., 22; [10] J. A. Mann, "Cotton Trade of Great Britain," 1860, p. 61.

INDIA: [11] "Correspondence on Cotton Cultivation in India" (Parliamentary Papers, 1863, XLIV., 1); [12] "Report of Mr. Rivett Carnac, Cotton Commissioner for the Central Provinces and the Berars, on the Operations of his Department for 1867" (Parliamentary Papers, 1868-9, XLVI., 397); [13] Brice, A. C., "Indian Cotton Supply" (London, 1863); [14] Fergusson, W. F., "Papers Connected with the Sale of Waste Lands," 1861, p. 8; [15] Gibbs, J., "Cultivation of Cotton in India"; [16] Haywood, G. R., "Report to Executive Committee of the Directors of the Manchester Cotton Company" (Manchester, 1862); [17] Mackay, A., "Western India" (London, 1853), p. 211; [18] Royle, F. J., "Measures adopted in India for the Improved Culture of Cotton" (London, 1857); [19] Smith, S., "Cotton Trade

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* Englishmen were interested in increasing the cotton grown in Egypt, which was nominally part of the Ottoman Empire, but really a semi-independent State. Haywood, on his way to India, examined the cotton estates of the Nile Delta, and it is interesting to note his comment: "Egypt is especially essential to us as a means of communication with our East Indian possessions, and it therefore behoves us to take every legitimate step for strengthening the commercial bonds which unite the two countries."[8]

of India " (London, 1863), p. 12; [20] Smollett, P. B., " India " (2nd ed., Glasgow, 1863); [21] Watts, I., " India as a Source of Cotton Supply " (Report to Cotton Supply Assn., 1870).

British Guiana: [22] Davis, N. D., " Cotton Planting in British Guiana " (in " Tracts on the Colonies," Brit. Mus., 1884, a, 6, 22); [23] Duff, R., " British Guiana " (Glasgow, 1866), pp. 168-198; [24] Holmes, Sir W. H., " Free Cotton: How and Where to Grow it " (London, 1862).

British West Indies: [25] Davis, N. D., " Cotton in the Old Days " (1904); " Cotton Planting in the British West Indies " (1904) (in " Tracts on the Colonies," Brit. Mus., 1884, a, 6, 23).

Australia: [26] Harding, R., " Cotton in Australia " (London, 1925), chap. 3, [27] Lang, J. D., " Cooksland in N. E. Australia: the Future Cotton Field of Great Britain " (London, 1847); [28] " Queensland: a Highly Eligible Field for Emigration and the Future Cotton Field of Great Britain " (London, 1861).

COTTON STATISTICS

CONSUMPTION AND STOCKS

BY

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A YEAR ago it was pointed out that the outstanding feature of the world's consumption during the season then closed was that, while the total world's consumption of All Kinds had not been seriously reduced, there had been a very marked transference of consumption from American to Outside Growths, and that in the second half of the season this had actually been carried so far that the world's consumption of Outside Growths was for the first time in history more than that of American. During the first half of the season 1930-31 this tendency was carried still further, and the world's consumption of Outside Growths (in bales) was actually 11·5 per cent. above that of American. But in the second half of the season there was some evidence of a swing back to American, and while Outside Growths still exceeded American the excess was only 1·1 per cent.

This relative recovery of American, however, was accompanied by a marked reduction of the world's total consumption, for, as will be seen from the last section of Table I., the world's consumption of All Kinds of cotton during the past season was only 22,488,000 bales against 25,201,000 in 1929-30. The following Table, which gives the consumption of each half-year back to 1926 of American

	American.			Outside Growths.			
Season.	*U.S.A.*	*Rest of the World.*	*Total.*	*U.S.A.*	*Rest of the World.*	*Total.*	*Per Cent. on American.*
	Running bales,		*000's.*	*Running bales*		*000's.*	
1926-27:							
1st Half ..	**3,284**	**4,137**	**7,421**	**117**	**5,190**	**5,307**	**71·5**
2nd ,, ..	**3,596**	**4,760**	**8,356**	**135**	**4,920**	**5,055**	**60·5**
1927-28:							
1st Half ..	**3,467**	**4,761**	**8,228**	**126**	**4,636**	**4,762**	**57·9**
2nd ,, ..	**3,068**	**4,111**	**7,179**	**110**	**5,262**	**5,372**	**74·8**
1928-29:							
1st Half ..	**3,300**	**4,308**	**7,608**	**113**	**5,142**	**5,255**	**69·1**
2nd ,, ..	**3,478**	**3,980**	**7,458**	**132**	**5,419**	**5,551**	**74·4**
1929-30:							
1st Half	**3,152**	**3,926**	**7,078**	**132**	**5,987**	**6,119**	**86·4**
2nd ,, ..	**2,651**	**3,286**	**5,937**	**117**	**5,950**	**6,067**	**102·2**
1930-31:							
1st Half ..	**2,377**	**2,901**	**5,278**	**77**	**5,809**	**5,886**	**111·5**
2nd ,, ..	**2,714**	**2,916**	**5,630**	**78**	**5,616**	**5,694**	**101·1**

versus Outside Growths, and distinguishes in each case the consumption in the U.S.A. from that of the rest of the world, summarizes the history of these eventful years. 1926-27 is chosen as the starting-point because that was the year of the bumper American crop and the record world's consumption of American. Comparing that season with this, the reduced consumption of American both in the U.S.A. and in other countries is very striking.

The history is also shown graphically in the diagram on page 67, which carries the half-yearly record back to January, 1921.

In all these comparisons it must of course be remembered that the Federation statistics are in running bales, and this introduces a fairly serious error into the comparisons. The American running bale weight is, of course, about 500 lbs., but the others vary from Egyptian, at say 750 lbs., down to Indian at 400 and perhaps as low as 250 lbs. in some cases. If the whole of the figures could be converted into a standard unit of 500 lbs. it would actually reverse the position in those half-years in which the consumption of Outside Growths was apparently more than American; but this does not alter the fact that the tendency of recent years has been for the world to use less American and more Outside Growths. The error in the bale weight being fairly constant makes very little difference in the comparison of the statistics from one season to another, except, of course, that the larger the proportion of Outside Growths the greater is the error.

As to the future, a year ago we indicated the possibility of a reaction in favour of American, but it is more difficult than ever now to make a similar forecast for the future because of two outstanding facts: (*a*) the extraordinary recovery of the American crop this year both in quantity (with the consequent fall of price) and in quality, and (*b*) the fact that England is now off the Gold Standard and that Egypt and India are linked to sterling. So far as it is possible to guess what is likely to happen in a matter so extraordinarily complex, the effect of this ought to be to make it less advantageous for many countries to buy American cotton than other varieties which come from countries no longer on the Gold Standard, and that, by the way, includes almost every cotton-growing country in the world except the United States. So far it appears that these two influences have been working in opposite directions. This season the exports from America, especially to the East, have already been abnormally large, and there is no sign yet of this being checked by the monetary handicap.

Certain points of detail in Table I. deserve comment, particularly with regard to Egyptian. During the second half of the season the world's consumption of Egyptian made a very definite recovery as compared with the first half. This was mainly attributable to the increased consumption in England, on the Continent, and in India, the last-mentioned being perhaps the most unusual development of all. Here, also, it may be noted with regret that no statistics have been available at all from Russia during the whole of the past season. During the first half of the season the Federation simply repeated the statistics of the previous half-year, but during the second half they made an estimate from independent sources. It so happens that during the past season Russia has been taking fairly large quantities of Egyptian, for the peculiar reason that owing to the shorter freight they could actually buy Uppers cheaper than American.

Table II. gives the details of the U.S. consumption of All Kinds of cotton during the past season and for the first three months of the new season. The value of these statistics is that being monthly they give an earlier indication of how things are moving than the Federation statistics, which are only half-yearly. They show that so far as America is concerned, consumption is steadily if rather slowly recovering from the low point of a year ago, and for some time now every month has been running well above last year's figures.

Changes in consumption have been reflected in the World's Carry-overs of American and Egyptian cotton which are given in Tables III. and IV. The position in both of these cases is very serious, and to put things in their proper perspective we give below two tables showing the prospective Season's Supply (*i.e.*, Crop plus Carry-over) and the consumption of American and Egyptian respectively. With regard to American, as the result of the enormous crop now in prospect for 1931 the season's supply is record-breaking

Season.	*Carry-over at Beginning of Season.*	*Crop.*	*Total Supply.*	*Consumption (Federation).*	*Season's Average Spot Price in Liverpool.*
	Running	*bales 000's*	*(ex-linters*	*throughout).*	*Pence per Lb.*
1920-21 ..	**5,656**	**13,271**	18,927	10.033	**11·89**
1921-22 ..	**9.141**	**7,978**	17.119	12,728	**11·37**
1922-23 ..	**5.028**	**9,729**	14,757	12,594	**14·92**
1923-24 ..	**3.235**	**10,171**	13,406	11,080	**17·66**
1924-25 ..	**2,665**	**13,639**	16.304	13.270	**13·76**
1925-26 ..	**3,324**	**16,123**	19,447	13,736	**10·77**
1926-27 ..	**5,358**	**17,755**	23,113	15,777	**8·15**
1927-28 ..	**7,484**	**12,783**	20,267	15.407	**11·17**
1928-29 ..	**4,952**	**14,297**	19,249	15,066	**10·52**
1929-30 ..	**4,332**	**14,549**	18,881	13,023	**9·09**
1930-31 ..	**6,249**	**13,756**	20 005	10,908	**5·71**
1931-32 ..	**8,815**	**16,918***	25,733	—	—

Estimate (500 lb. bales).

by a long way, but the comparison with the previous record of 1926 is made still worse when it is realized that in those days the world's consumption was nearly 16 million bales, whereas last season it was barely 11 millions!

Thus the prospective supply today is much more than twice last season's consumption, and it will require a very substantial increase in the consumption this season to prevent the Carry-over at July 31 next amounting to 13 million bales.

With regard to Egyptian, the position, as will be seen from the next Table, is almost as bad.

Season.	*Carry-over at Beginning of Season.*	*Crop.*	*Supply.*	*Consumption (Federation).*	*Season's Average Spot Price in Liverpool.*
		Kantars 000's.			*F.G.F. Sakel.*
1920-21 ..	3,612	6,030	9.642	3.850	30·24
1921-22 ..	4,484	4,858	9.342	5.500	19·75
1922-23 ..	4,485	6.213	10,698	6.700	17·29
1923-24 ..	3,996	6,531	10,527	7,700	21·55
1924-25 ..	2,349	7.274	9.623	7,300	29·82
1925-26 ..	2,222	7,965	10.187	6,900	20·05
1926-17 ..	3,658	8.635	12,293	7,450	15·39
1927-28 ..	4,712	6,097	10.809	7,200	19·39
1928-29 ..	3,573	8,012	11,585	7.400	18·14
1929-30 ..	4,243	8,485	12,728	7,028	14·52
1930-31 ..	6,131	8,015	14,146	6,398	9·06
1931-32 ..	6,959	6,205	13,164		

Owing to a substantial reduction of the area in Egypt this year and the comparative failure of the expected crop, the prospective season's supply is actually less than it was a year ago, but it is still more than twice as much as last season's consumption.

With regard to the American Carry-over a new complication has been introduced by the inclusion in the returns since January, 1931, of a figure for Oriental stocks with corresponding figures a year earlier. We have given effect to this meantime by including these Oriental stocks in the half-yearly figures for January and July, 1930, and every month since January, 1931, and showing these figures in italics. The main point of the Oriental stocks is that so far at least they have not been following the normal seasonal movement of the stocks of American cotton in other parts of the world. Thus, during the second half of last season the Oriental stocks mounted steadily, while all the other items in the Carry-over were following their usual seasonal decline; but it is too soon yet to say whether this is going to be a normal movement in future seasons.

TABLE I.—WORLD'S CONSUMPTION OF COTTON.

(From the Statistics of the International Federation.)

(*Running Bales, 000's Omitted—Excluding Linters.*)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*All Others.*	*Totals*
American ..	1911-13*	3,701	4,865	5,086	513	132	14,297
	1923-24	1,695	3,199	5,353	661	172	11,080
	1924-25	2,344	4,009	5,917	772	228	13,270
	1925-26	2,093	4,194	6,176	1,012	261	13,736
	1926-27	2,077	4,797	6,880	1,756	267	15,777
	1927-28	1,949	5,143	6,535	1,513	267	15,407
	1928-29	1,910	4,614	6,778	1,431	333	15,066
	1929-30	1,474	4,055	5,803	1,427	256	13,015
	1930-31	991	3,242	5,091	1,345	239	10,908
	1st Half	*493*	*1,689*	*2 377*	*602*	*117*	*5,278*
	2nd ,,	*498*	*1,553*	*2,714*	*743*	*122*	*5.630*
Indian ..	1911-13*	49	807	5	3,043	1	3,905
	1923 24	201	1,247	27	3,922	7	5,404
	1924-25	183	1,108	31	4,165	34	5,521
	1925-26	168	1,063	30	4,273	38	5,572
	1926-27	82	855	28	4,203	28	5,196
	1927 28	121	962	27	3,389	24	4,523
	1928-29	183	1,150	35	3,766	44	5,178
	1929-30	188	1,375	61	4.403	60	6 087
	1930 31	252	1,215	43	4,318	35	5,863
	1st Half	*131*	*656*	*22*	*2,185*	*19*	*3 013*
	2nd ,,	*121*	*559*	*21*	*2,133*	*16*	*2,850*
Egyptian ..	1911-13*	384	377	127	20	7	915
	1923 24	469	354	149	39	16	1,027
	1924-25	431	350	128	49	13	971
	1925-26	391	334	136	42	17	920
	1926-27	369	389	160	51	25	994
	1927-28	358	394	145	43	17	957
	1928-29	365	401	155	43	25	989
	1929-30	301	415	137	58	26	937
	1930-31	242	420	70	96	25	853
	1st Half	*113*	*197*	*35*	*35*	*14*	*394*
	2nd ,,	*129*	*223*	*35*	*61*	*11*	*459*
Sundries ..	1911-13*	140	1,946	26	774	939	3,825
	1923 24	353	529	76	1,351	576	2,885
	1924-25	277	896	66	1,523	785	3,547
	1925-26	370	1,619	58	1,308	1,103	4,458
	1926-27	482	1,511	64	1,362	753	4,172
	1927-28	476	1,557	64	1,646	911	4,654
	1928-29	342	1,947	55	1,480	815	4,639
	1929-30	502	2.044	51	1,825	740	5.162
	1930-31	479	1,984	42	1,648	711	4,864
	1st Half	*239*	*1 064*	*20*	*839*	*317*	*2.479*
	2nd ,,	*240*	*920*	*22*	*809*	*394*	*2 385*
All kinds ..	1911-13*	4,274	7,995	5,244	4,350	1,079	22,942
	1923-24	2,718	5,329	5,605	5,973	771	20,396
	1924-25	3,235	6,363	6,142	6,509	1,060	23,309
	1925-26	3,022	7,210	6,400	6,635	1,419	24,686
	1926-27	3,010	7,552	7,132	7,372	1,073	26,139
	1927-28	2,904	8,056	6,771	6,591	1,219	25,541
	1928-29	2,800	8,112	7,023	6,720	1,217	25,872
	1929-30	2.465	7,889	6,052	7,713	1,082	25,201
	1930-31	1.964	6,861	5,246	7,407	1,010	22,488
	1st Half	*976*	*3,606*	*2,454*	*3 661*	*467*	*11,164*
	2nd ,,	*988*	*3,255*	*2,792*	*3.746*	*543*	*11,324*

* **Average of 1911-12 and 1912-13.**

TABLE II.—U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

		Total.	*Upland.*	*Sea Island.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
Season's Totals.	1912–13	5,483·4	5,195·6	54·8	—	201·3	31·7	303·0
	1913–14	5,577·4	5,301·4	81·7	—	151·1	43·2	307·3
	1914–15	5,597·4	5,295·9	79·4	—	181·2	40 8	411·8
	1915–16	6,397·6	5,998·0	82·6	—	269·3	47·7	880·9
	1916–17	6,788·6	6,376·0	94·3	—	259·2	59·1	869·7
	1917–18	6,566·5	6,296·8	85·9	—	136·4	47·4	1,118·8
	1918–19	5,766·0	5,517·6	51·2	21·1	126·1	50·0	457·9
	1919–20	6,419·8	5,914·2	43·0	45·9	323·1	93·6	342·5
	1920–21	4,892·7	4,641·5	18·7	16·8	159·2	56·6	516·3
	1921–22	5,909·9	5,554·7	9·0	49·4	226·3	70·5	639·0
	1922–23	6,666·1	6,250·8	6·3	65·2	262·3	81·5	646·1
	1923–24	5,680·6	5,312·0	4·9	36·0	223·6	104·0	536·7
	1924–25	6,193·4	5,894·5	4·0	19·0	191·5	84·4	658·8
	1925–26	6,455·9	6,161·7	2·3	11·7	204·1	76·0	803·8
	1926–27	7,189·6	6,859·2	1·2	19·7	239·8	69·7	806·1
	1927–28	6,834·1	6,518·6	1·3	15·1	217·6	81·5	780·2
	1928–29	7,091·1	6,763·9	0·8	13·5	232·4	80·5	879·3
	1929–30	6,113·9	5,790·4	—	12·6	205·8	96·7	805·2
	1930–31*	5,270·9	5,076·4	—	15·0	104·6	75·0	709·5
Monthly Figures, 1929–30.	August	558·8	529·0	—	1·4	20·3	8·0	83·6
	September	545·8	518·2	—	1·0	17·5	9·1	81·9
	October	640·8	609·0	—	1·5	20·2	10·0	82·7
	November	544·1	517·6	—	1·0	18·5	7·0	63·4
	December	453·9	428·6	—	1·0	18·0	6·2	52·5
	January	577·2	548·8	—	1·1	19·7	7·7	62·4
	February	495·2	469·3	—	0·9	17·0	7·8	60·9
	March	508·6	483·3	—	0·9	15·8	8·6	64·0
	April ..	532·4	503·9	—	1·0	18·1	9·4	67·0
	May ..	473·9	449·0	—	0·9	15·9	8·0	68·8
	June ..	405·2	384·0	—	0·8	13·3	7·1	58·5
	July ..	378·8	359·1	—	0·7	11·7	7·2	58·6
Monthly Figures, 1930–31.	August	352·3	338·6	—	0·6	7·7	5·5	57·0
	September	394·3	378·8	—	0·5	7·9	6·9	62·8
	October	444·5	426·4	—	0·6	9·9	7·7	66·2
	November	414·9	399·0	—	0·8	9·1	6·0	54·8
	December	406·2	390·1	—	0·9	10·1	5·1	44·0
	January	454·2	439·4	—	1·2	7·8	5·8	49·3
	February	433·5	417·4	—	1·3	8·4	6·4	53·1
	March	490·6	472·5	—	1·6	8·8	7·7	62·8
	April ..	508·7	490·5	—	1·7	9·7	6·9	66·8
	May ..	465·8	449·5	—	1·4	8·7	6·2	66·9
	June ..	455·4	439·0	—	1·5	8·9	6·1	61·4
	July ..	450·5	436·6	—	1·4	7·7	4·8	64·4
1931–32.*	August	425·8	414·0	—	1·3	5·7	4·9	60·7
	September	463·7	449·4	—	1·8	7·1	5·5	63·9
	October	462·0	449·8	—	1·3	6·6	4·3	61·0

Subject to revision.

TABLE III.—WORLD'S MONTHLY CARRYOVER OF *AMERICAN*

(IN THOUSANDS OF RUNNING BALES, INCLUDING LINTERS IN U.S.A., ALSO SEA ISLAND AND AMERICAN EGYPTIAN, BUT NOT FOREIGN COTTON.)

COTTON.

End of	*Stock and Afloat.*		*U.S.A.*		*Monthly Totals.*	*Federation.*	*Half-Yearly Totals.*	*U.S.A.*	*End of Season Totals.*
	U.K.	*Continent.*	*Mill Stocks.*	*Public Warehouses.*		*Other Mill Stocks.*		*Elsewhere.*	
1912, August ..	508	406	786	556	2,256	1,305	3,561	350	3,911
1913, August ..	423	282	699	492	1,896	1,011	2,907	375	3,282
1914, August ..	627	489	687	562	2,365	—	—	320	—
1915, July ..	1,238	753	1,491	1,839	5,321	—	—	850	—
1916, July ..	707	516	1,591	1,150	3,964	—	—	450	—
1917, July ..	237	332	1,521	1,069	3,159	—	—	440	—
1918, July .	173	164	1,541	1,924	3,802	—	—	315	—
1919, July ..	806	486	1,519	2,402	5,213	—	—	1,150	—
1920, July ..	878	474	1,485	2,262	5,099	1,066	6,165	500	6,665
1921, July .	839	805	1,222	3,874	6,740	1,137	7,877	1,960	9,837
1922, July ..	558	562	1,266	1,468	3,854	1,243	5,097	185	5,282
1923, July ..	187	206	1,109	903	2,405	713	3,118	310	3,428
1924, July .	228	310	739	695	1,972	688	2,660	220	2,880
1925, July ..	401	373	916	516	2,206	1,046	3,252	270	3,522
1926, July ..	579	406	1,155	1,946	4,086	959	5,045	595	5,640
1927, July ..	1,011	1,079	1,524	1,856	5,470	1,731	7,201	590	7,791
1928, July ..	530	815	1,094	1,201	3,640	1,181	4,821	385	5,206
1929, July ..	442	563	1,119	981	3,105	1,197	4,302	360	4,662
August ..	367	418	834	1,370	2,989	—	—	—	—
September	339	584	808	3.207	4,938	—	—	—	—
October ..	454	1,000	1,401	5.323	8,178	—	—	—	—
November	528	1,145	1,742	5,869	9,284	—	—	—	—
December	583	1,275	1,928	5,949	9,735	—	—	—	—
1930, January ..	618	1,198	1,928	5,437	*9,029*	1,007	*10,636*	—	—
February	572	1,148	1,934	4,906	8,560	—	—	—	—
March ..	509	1,085	1,892	4,241	7,727	—	—	—	—
April ..	484	990	1,799	3,687	6,960	—	—	—	—
May ..	402	775	1,641	3,345	6,163	—	—	—	-
June ..	352	660	1,447	3,117	5,576	—	—	—	—
July ..	304	544	1,287	2,890	*5,168*	937	*6,105*	630	*6,735*
August ..	275	472	1,108	3,472	5,327	—	—	—	—
September	322	747	1,058	5,246	7,373	—	—	—	—
October ..	415	1,055	1,456	7,551	10,477	—	—	—	—
November	551	1,217	1,684	8,417	11,869	—	—	—	—
December	648	1,299	1,808	8,414	12,169	—	—	—	—
1931, January ..	644	1,198	1,784	7,978	*11,947*	907	*12,854*	—	—
February	628	1,185	1,734	7,360	*11,243*	—	—	—	—
March ..	603	1,238	1,686	6.686	*10,650*	—	—	—	—
April ..	573	1,109	1,580	6,080	*9,822*	—	—	—	—
May ..	547	1,029	1,454	5,524	*8 972*	—	—	—	—
June ..	488	874	1,314	4,989	*8.072*	—	—	—	—
July ..	436	766	1,179	4,536	*7,318*	950	*8,268*	1,049	*9,317*
August ..	371	643	998	4,436	*6,770*	—	—	—	—
September	320	700	911	6,306	*8,714*	—	—	—	—
October ..	381	801	1,250	9.464	*12.430*				
November	452	898							

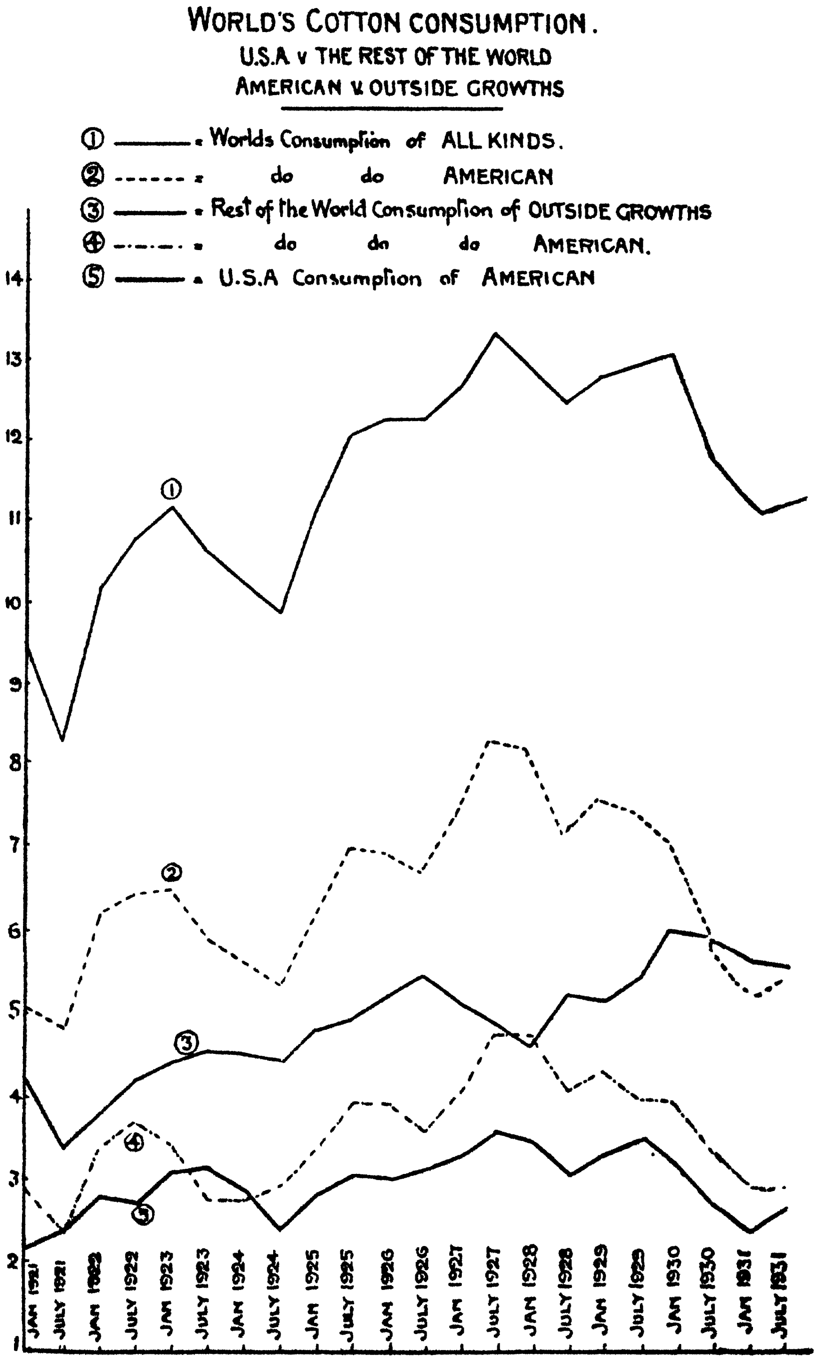
TABLE IV.—WORLD'S MONTHLY CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000'S BALES CONVERTED AT 7·5 KANTARS (EUROPE) AND 5·0 KANTARS (U.S.A.).)

End of	*Stock and Afloat.*		*U.S.A.*		*Alex-andria.*	*Monthly Total.*	*Federation.*	*Half-Yearly Totals.*
	U.K.	*Conti-nent.*	*Mills.*	*Ware-houses.*			*Half-Yearly.*	
1912, August ..	302	30	424*	—	350	1.106	1,387	2,493
1913, August ..	418	31	354	13	491	1,307	1,485	2,792
1914, August ..	467	10	259	26	766	1,528	—	—
1915, July ..	758	71	484	126	1,074	2,513	—	—
1916, July ..	351	50	617	296	104	1,418	—	—
1917, July ..	431	27	376	213	589	1,636	—	—
1918, July ..	541	185	180	157	1,727	2,790	—	—
1919, July ..	526	170	185	79	2,060	3,020	—	—
1920, July ..	466	79	587	514	601	2,247	1,365	3,612
1921, July ..	688	158	345	296	1,992	3,479	1,005	4,484
1922, July ..	835	148	314	267	1,669	3,233	1,252	4,485
1923, July ..	859	129	447	265	1,096	2,796	1,200	3,996
1924, July† ..	360	128	259	63	384	1,194	1,155	2,349
1925, July .	323	75	253	57	411	1,119	1,103	2,222
1926, July ..	345	120	321	143	1,544	2,473	1,185	3,658
1927, July ..	533	143	295	66	2,392	3,429	1,283	4,712
1928, July ..	465	98	239	88	1,648	2,538	1,035	3,573
1929, July ..	510	150	449	197	1,677	2.983	1,260	4,243
August ..	450	165	458	174	1.164	2.411	—	—
September ..	368	120	454	162	1,332	2,436	—	—
October ..	465	180	397	142	2,536	3.720	—	—
November ..	555	240	361	128	3,164	4,448	—	—
December ..	638	233	361	162	3,223	4,617	—	—
1930, January ..	585	270	346	202	3.403	4,806	1,335	6,141
February ..	570	270	331	183	3,677	5,031	—	—
March ..	555	187	330	172	3.937	5,181	—	—
April ..	450	218	336	149	3,984	5,137	—	—
May ..	435	188	449	279	3,931	5,282	—	—
June ..	375	188	507	269	3.760	5,108	—	—
July ..	353	135	483	245	3,616	4,834	1,297	6,131
August ..	285	120	435	243	3,457	4,540	—	—
September ..	270	120	399	234	3.622	4,645	—	—
October ..	353	270	376	215	4,327	5,541	—	—
November ..	525	255	374	165	4.875	6.194	—	—
December ..	623	278	351	147	5,264	6.663	—	—
1931, January ..	630	293	334	129	5,349	6.735	1,185	7,920
February ..	660	255	304	135	5.202	6,556	—	—
March ..	623	210	292	116	5,199	6,440	—	—
April ..	570	225	276	122	5.003	6,216	—	—
May ..	525	218	252	124	4.816	5,935	—	—
June ..	510	165	232	118	4,716	5.741	—	—
July ..	600	165	212	108	4,456	5,541	1,418	6,959
August ..	578	173	196	102	4 119	5,248	—	—
September ..	525	165	186	98	4.143	5,117	—	—
October ..	570	218	174	87	4,853	5,902	—	—
November ..	795	218			5,611		—	—

* Total foreign—details not given.

† Excluding Sudan cotton in Liverpool since 1924.


WORLD'S COTTON CONSUMPTION.
U.S.A v THE REST OF THE WORLD
AMERICAN v. OUTSIDE GROWTHS
① ——— = Worlds Consumption of ALL KINDS.
② - - - - - - = do do AMERICAN
③ ——— = Rest of the World Consumption of OUTSIDE GROWTHS
④ -·-·-·- = do do do AMERICAN.
⑤ ——— = U.S.A Consumption of AMERICAN
①
②
③
④
⑤
14
13
12
11
10
9
8
7
6
5
4
3
2
1
JAN 1921
JULY 1921
JAN 1922
JULY 1922
JAN 1923
JULY 1923
JAN 1924
JULY 1924
JAN 1925
JULY 1925
JAN 1926
JULY 1926
JAN 1927
JULY 1927
JAN 1928
JULY 1928
JAN 1929
JULY 1929
JAN 1930
JULY 1930
JAN 1931
JULY 1931

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. The following reports have recently been received:

Ahmedabad: Rpt. of the Millowners' Assocn., 1930-31.
Mysore: Agr. Calendar, 1931.
Punjab: Rpt. on Operations of Dpt. of Agr., 1930, Pt. I.

2. **Cotton Improvement in India.** (*Ind. Cent. Cot. Comm.*, 1931.) In this pamphlet the broad general outlines of policy of the Committee laid down in 1925 are stated. The work carried out and in progress for the improvement of Indian cottons is detailed, and proposals for future work are outlined. A scheme is under consideration by the Committee for investigating the cost of growing cotton under conditions of peasant proprietorship in each of the main cotton-growing Provinces and States in India. When completed, this should furnish much valuable and authoritative information.

The work of the Technological Laboratory is discussed by Dr. Ahmad; Part I. of the note is devoted to a review of the activities of the laboratory since its inception in 1923-24, and Part II. contains suggestions for extending the scope of these activities, and a programme of research for the near future. A recent change in the Laboratory's policy is the decision to carry out tests for the trade; hitherto these had only been carried out for the Agricultural Departments. When the results of the tests are available for a number of years the accumulated information should prove most valuable to the trade.

3. **Cotton in the Punjab.** (*Rpt. on Operations of the Dpt. of Agr.*, 1930, Pt. I.) Investigations were carried out as to the probable causes of the partial failure of American cotton in certain years in the past. Results indicated that no one factor could be held responsible for such failures, which seemed to be due to the cumulative effect of a number of unfavourable circumstances operating at different times. Valuable work was done in the Cotton Research Botanist's section during the year, and a large number of pure line families of both American and Desi cottons were under trial. The new "Early" strain of American cotton found favour with the proprietors of certain estates on which it was tried, but the Department considers that further trials are necessary before it can be recommended for general distribution.

The research scheme in connection with pink bollworm, financed by the Indian Central Cotton Committee, was continued. Other pests encountered during the year included locusts, grasshoppers, and crickets.

4. **Spinning Test Reports.** By N. Ahmad. (*Ind. Cent. Cot. Comm. Tech. Circs.*, Nos. 55 and 57-59.) The circulars contain the report of the Standards Committee and spinning test results for Dholleras, Westerns, Farm Westerns, Kumpta, Kalagin, Bijapore, Bhagalkote, Upland, Cambodia, Karunganni, Kadiviramgam, and Tinnevelly cottons for the 1930-31 season.

Circ. No. 56 contains the report of the Special Appeal Committee on African cotton and the spinning test results for A. R. Kampala, A. R. Busoga, and A. R. Jinja cottons for the 1930-31 season.

5. **Technological Reports on Standard Indian Cottons 1931.** By N. Ahmad. (*Tech. Bull.*, Ser. A., No. 18. Indian Central Cotton Committee, 1931.) The reports contain the results of tests on standard cottons of the eight seasons 1923-31.

As in former years the Agricultural Details, Grader's Reports, Fibre Particulars, Spinning Tests Reports, and Remarks are given for each of the twenty-one standard Indian cottons. This year a Punjab cotton, Punjab-American 285 F., has been omitted from the list. This variety has not only given a poor average yield over several seasons, but has been found highly susceptible to climatic conditions, and has practically gone out of cultivation.

Of the 21 cottons tested, 11 have shown an improvement, 6 have remained stationary, and 4 have suffered set-back. Hagari 1 and Hagari 25 have shown the greatest improvement, being suitable for highest standard warp counts of 36's as against 27's and 25's respectively for last season.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

6. The following reports have recently been received:

ROTHAMSTED EXPERIMENTAL STATION: Rpt. for 1930.
FIJI: Ann. Rpt. of Dpt. of Agr. for the year 1930.
KENYA COLONY: Agr. Census, 1931.
NIGERIA: *Northern Provinces.* Ann. Rpt., 1930.
QUEENSLAND: Ann. Rpt. of Exper. Work on Cotton, Callide Cot. Res. Sta., 1929-30.
SIERRA LEONE: Ann. Rpt. of Dpt. of Agr., 1930.
SOUTH AFRICA: Year Book, 1929-30.
TANGANYIKA: Tsetse Res. Ann. Rpt., 1930.
UGANDA: Ann. Rpt. of Dpt. of Agr., 1930, Pts. I. and II.
  Meteorological Observations, 1930.
WEST INDIES: *Antigua.* Rpt. on Agr. Dpt., 1930-31.
  Barbados. Rpt. on Dpt. of Sci. and Agr., 1930-31.
  Grenada. Rpt. on Agr. Dpt., 1930.
  St. Kitts-Nevis. Rpt. on Agr. Dpt., 1930-31.
  St. Vincent. Rpt. on Agr. Dpt., 1930.

7. THE CROWN COLONIST. A preliminary number of this new monthly journal was issued in April last (*cf.* Abstr. **359**, Vol. VIII., of this Review), and we have now received a copy of the first issue of Vol. I. published in December. This is the first attempt made to publish a journal which, covering the Colonial Empire as a whole, makes its special concern the trade and industry, public services and private enterprises, growth and economic development of all the Colonies, their relations with one another, with the rest of the Empire, and especially with Great Britain. The journal will have no politics and no other aim than to foster the welfare of the Colonies and their relations with the mother country.

The principal contents of the present number, which is excellently illustrated, are as follows: " Colonial Markets: their Importance to British Trade " (Rt. Hon. Sir E. Hilton Young); " Colonial Tariffs and Preferences: A Summary of the present Position;" " A Great African Trading Enterprise " (G. I. Lloyd); " Science and the Empire Producer " (a descriptive account of what the Empire Marketing Board is doing for the Colonies); " Colonial Forest Resources " (W. G. Freeman); " Personal Health in the Tropics " (Lt.-Col. G. E. F. Stammers); " Economic Conditions in Malaya " (R. Boulter); " Round the Colonial Empire " (a monthly survey of the essential news of all the Colonies). In addition to the above there are sections devoted to Current Topics, Special Correspondents' Reports, Recent Literature, etc.

8. EMPIRE COTTON GROWING. PRODUCTION AND CONSUMPTION. By J. A. Todd. (*Trop. Agriculture*, viii., **9**, 1931, p. 240.) A very clear and readable historical article on the subject, with useful illustrative tables. The author points out that although figures during the past year or two have shown no increase, there is no

reason to be discouraged, since the abnormal period of depression throughout the world will certainly pass, and the demand for cotton goods will then revive. He writes in conclusion: "The Empire crops, while not in themselves very large in quantity, have played a very important part by filling up gaps here and there in the world's supplies, and they have more than justified all the labour and expenditure that has been devoted to them. It would be the greatest possible mistake, even under the present adverse conditions, to allow the results of thirty years' work to lapse. The time will come again when we shall want Empire cotton as badly as ever, and the organizations of the British Cotton Growing Association and the Empire Cotton Growing Corporation, which have been built up through these years, must be maintained in their full efficiency."

9 ROTHAMSTED EXPERIMENTAL STATION. The Report for 1930 describes the work carried out in connection with manurial and rotation experiments with various crops, soil problems, and insect pests and diseases. Summaries are included of over 100 papers published in various scientific journals during the year. In view of the great expansion of the work of the Station during the last ten years, the Committee has deemed it advisable to acquire the adjoining sites in readiness for the time when further accommodation will be necessary.

10. GOLD COAST. *Cotton Experiments.* (*Bull. of Imp. Inst.*, xxix., 3, 1931, p. 337.) During the 1930-31 season three promising strains of cotton, T66, T57, and D28, isolated at Tamale in the previous season, were subjected to small bulk trials. D28 gave an increased yield (181 lb. per acre), but the two other strains were disappointing. Of 23 new varieties tried (11 American, 3 Native, and 9 Asiatic) only 2 Asiatics—Coconadas and Karunganni—showed any promise.

Cotton trials were continued at Kpeve, the Improved Ishan cotton from Nigeria giving distinctly promising yields of 498 lb. per acre, as compared with 283 lb. per acre for the local Sonko variety.

Manurial trials indicated that without treatment to improve organic content of the soil, artificials were of little use. The beneficial effect on cotton of a previous green manure crop was shown in the rotation investigation. Following upon a crop of Bengal beans which had been dug in, Allen cotton yielded an average of 328 lb. per acre, compared with 157 lb. in the previous season when no green manuring was practised.

Bollworm was the principal pest encountered during the season, and damage was also caused by a beetle, *Syagrus calcaratus.*

11. KENYA COLONY. *Cotton Industry.* (*Agr. Census*, 1931, p. 29.) In 1930-31 there were three ginneries operating in the Colony, with a total number of 24 gins working. The total quantity of cotton purchased was 990,006 lb., almost entirely grown by natives. The average buying price for "A" quality cotton was 9·82 cents per lb., and for "B" quality 4 cents per lb.

12. A DECADE OF AGRICULTURAL PROGRESS IN KENYA. By Hon. A. Holm. (*Bull. No.* 9 *of* 1931. Kenya Colony.) In 1920 there were 1,183 European occupiers in the Colony in occupation of 3,157,440 acres, and in 1930 the figure had risen to 2,097 occupiers who were in possession of 5,111,161 acres. This represents an increase of 77 per cent. for occupiers and 62 per cent. for occupied land. The total area cultivated in 1920 was returned at 176,290 acres, and in 1930, 643,644 acres, which is equivalent to an increase over the period of 467,354 acres, or 265 per cent. The labour supply is now adequate, and the use of agricultural machinery has considerably increased. The value of the agricultural exports has risen from £669,202 in 1920 to £2,901,038 in 1930. It is anticipated that the prevailing depression will unfortunately check the rate of progress for a period, but that the greatness of the resources of the Colony will enable it to recover comparatively soon after the return of market prices to normality.

13. NIGERIA. *Cotton Investigations.* (*Bull. of Imp. Inst.*, xxix., 3, 1931, p. 338.) The report of the Botanical Branch, Southern Provinces, for the half-year ended June 30 contains accounts of investigations on the behaviour of Ishan cotton when grown through (*a*) early maize and (*b*) late maize. The usual routine for the selection and multiplication of Ishan cotton has been continued, but in view of the market dislike for rough cottons, efforts are being made by Dr. Harland in Trinidad to remove this character from the Ishan plant. Seed of Sea Island and Big Boll Okra cottons has been received from the West Indies for trial.

From the report of the Agricultural Botanist, Northern Provinces, we learn that strain " D," which was grown over 400 acres at Daudawa, having proved susceptible to jassid, has been discarded. In a yield trial of four Allen selections (L, B, C, and Strain 18) against commercial Allen as a control, strain L was the only one to equal commercial Allen in yield. In a second yield trial of one Allen selection and three exotics (Strain 1, A12·5, H21·3, and U4·5) against commercial Allen, all strains, except H21·3, yielded as well as the control. In multiplication trials, 20 acres each of H21·3, J, G, U4 (200 lb. from Rhodesia), and D are being grown at the Corporation's Seed Farm at Daudawa in isolated plots. If H21·3 and U4 are to be continued they will have to show an improvement in yield, which they may do at Daudawa. Strain D is being grown as a control to observe relative jassid infection in J and G. At the same time strains L and C and a number of other promising strains are being bulked in isolation plots.

Up to the present no improved cotton has been found for the Middle Belt. Kabba appears the most suitable variety since it yields well, but it is extremely late maturing and very glabrous. Selection work for early maturity, quality, and yield is being carried out with this cotton.

14. *Cotton Cultivation in Northern Provinces.* (*Ann. Rpt. on. N. Provinces*, 1930, recently received.) The total purchases of cotton amounted to only 14,000 bales, as compared with 34,000 bales in the previous season. There is no doubt, however, that the cotton industry is firmly established, and that when growers accustom themselves to the lower level of prices for all forms of produce, cotton-growing will resume its normal position.

In Ilorin Province experiments are being continued with Munshi and Kabba cottons to find a strain suitable for local conditions, since the Improved Ishan cotton has not proved so successful here as in the Southern Provinces. The " D " strain of cotton, which proved superior in every respect to ordinary commercial cotton, has unfortunately been found susceptible to jassid attack. The Botanist, however, has several other strains which appear quite equal to " D " and are more or less jassid-resistant, and these are now being fully tested.

15. SOUTHERN RHODESIA. *Revised Notes on Cotton-Growing.* By G. S. Cameron. (*Rhod. Agr. J.*, xxviii., No. 10, 1931, p. 903.) Hints on cotton-growing previously given to farmers in Southern Rhodesia are revised in the light of experience gained during the past year. The notes refer to the following: choice of land, fertilizers, date of sowing, planting, spacing, cultivation, stainer traps, picking, sorting, issue of special seed, ratooning.

[*Cf.* Abstr. 15, Vol. VII., p. 55.]

16. UGANDA. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1930.) Owing to the extension of experimental work in the Department, it has been decided to publish the Report in two parts : Part I. Administrative ; Part II. Reports on scientific work and the results of experiments. From Part. I., recently received, we learn that owing to the serious effect of blackarm disease in some areas of the Eastern Province in 1929, it was considered inadvisable to use seed from these districts for planting in 1930, and 1,730 tons of seed were obtained from Busoga, where the disease had been practically absent. Weather

conditions in most districts were favourable for cotton, and blackarm did not cause any extensive injury during the season. The chief pests and diseases encountered during the year were *Helopeltis bergrothi* (which appeared for the first time), *Lygus vosseleri*, aphids, bollworms, leaf miner, jassids, and angular leaf spot disease.

The number of ginneries licensed to gin and bale cotton during 1930 was 123, compared with 153 in 1929. The Cotton Grader reported that on the whole the ginning of the crop was satisfactory, but in many cases sufficient care was not exercised in preventing damage to the lint by oil stains, and in the supervision of pressing.

The amount of Cotton Tax collected was £136,333, compared with £230,988 in 1929, the basis of taxation being 5 and 6 cents respectively.

Lack of money was a limiting factor in native ploughing, particularly in Teso, which suffered most from the failure of the previous cotton crop, and an increase of 253 ploughs over last year for this district was considered satisfactory. In Bugwere ploughing made good progress, and the Agricultural Officer reported an increase of 250 ploughs.

The Jinja-Kampala extension of the Kenya and Uganda Railway was practically completed by the end of the year, and the first through connection between Kampala and the coast was obtained by the opening of the Nile Bridge by His Excellency the Governor on January 14, 1931. Motor transport is still an increasing factor in the movement of the cotton crop.

17. *Cotton Prospects.* The report issued in October by the Dept. of Agriculture states that approximately 866,751 acres have been planted to cotton, compared with a total of 738,677 acres in 1930. From nearly all districts favourable reports on the condition of the crop have been received.

18. AUSTRALASIA: QUEENSLAND. *Cotton Industry.* (*Dalgety's Ann. Wool Rev.*, 1930-31, p. 155.) Following the general rain which fell in all sections of the Queensland cotton belt during the early part of May, fairly good weather has since prevailed, and harvesting has not suffered any undue delay. A good top crop has developed on the early planted cotton, and an excellent yield is anticipated in the Burnett country and southern cotton-growing districts of the State.

19. *Cotton Seed Importations.* (*Queens. Agr. Jour.*, xxxvi., 3, 1931, p. 350.) The Minister for Agriculture and Stock, in a recent announcement, stated that owing to the risk of introducing dangerous pests and diseases he was unable to accede to the request of a deputation of members of the Cotton Board and growers from Central Queensland that 20 tons of seed should be imported from America. He had, however, asked the U.S. Dept. of Agriculture to send 100 lb. of each of the three most promising varieties tried last season, and these amounts would allow of at least 10 acres of each variety being planted, and given reasonable conditions, sufficient seed should be available for planting several hundred acres in the following year.

20. *Cotton Experimental Work, Callide Research Station*, 1929-30. By W. G. Wells. (*Ann. Rpt. of Call. Cot. Res. Sta.*, 1931.) The climatic conditions during the cotton season were again unfavourable for obtaining very satisfactory results in many of the experiments. Among the recommendations made are the following: early planting to increase the possibilities of obtaining good yields; soaking seed for three hours prior to planting in order to assist germination; spacing plants 2 ft. apart in drills with rows 4½ ft. apart.

During the season much injury was caused to cotton by the corn-ear worm, false wire-worm, and false stainer, but the damage from pink bollworm, rough bollworm, thrips, and cutworms was considerably less. Flower beetles (*Carpo-*

philus sp.)—called locally " coon bugs "—occurred in large numbers and greatly handicapped the operations connected with the selfing work in the progeny breeding block. They enter into the flowers sometimes two days before the corolla opens, and destroy the stamens and often much of the staminal column and the petals.

21. Fiji. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1930.) Late planting and drought conditions prevailed throughout the year, and all cotton, except in the Sigatoka district, was more or less dwarfed. Owing to late planting growers were advised to use closer spacing; this brought the yield to within 5 per cent. of the average for the previous seven years, which, in the circumstances, was considered very good.

Purchases of seed cotton at the two ginneries at Lautoka and Sigatoka totalled 535,738 lb. as compared with 344,399 lb. for the previous year. Approximately one-half was Sea Island cotton, and the remainder a Kidney selection. The depression in the cotton market resulted in very low prices being realized, and it was regretfully decided to discontinue the planting of the New Guinea Kidney hybrid, a variety which does not command a place among " speciality " cottons, and cannot therefore bear heavy transport and overhead charges. A new Kidney Sea Island back-cross has shown considerable promise; it yields heavily and appears a suitable type to replace Sea Island.

Seed selection work, and spacing and ratoon experiments were continued by Mr. Anson at the Cotton Experimental Station, and the work in connection with rotation crops was extended with a view to providing native growers with a selection of balance crops essential to small holdings.

The injury from pests and diseases during the year was the lowest since the revival of the industry in 1923.

22. WEST INDIES: Antigua. *Cotton Industry.* (*Rpt. on Agr. Dpt.*, 1930-31.) The acreage planted for the 1930 crop was approximately 1,500 acres. Climatic conditions were unsuitable and attacks of cotton caterpillar severe, resulting in a poor yield, the estimated 1930-31 crop being about 350 bales of 300 lb. each. Pink bollworm was also very prevalent during the season, but caused little damage.

Very poor results were obtained in the selection work with cotton at the experimental station at Skerretts owing to the dry weather and unsuitable soil. The Department has been advised to obtain sufficient pure strain seed from Montserrat to establish a seed plot, and to concentrate on maintaining the purity of the imported seed.

23. Barbados. *Cotton Cultivation.* (*Rpt. on the Dpt. of Sci. and Agr.*, 1930-31.) It is gratifying to record that notwithstanding the depression in the Sea Island market, a considerable amount of the crop from the 2,800 acres planted was disposed of at a very fair price.

The Department published a pamphlet (No. 4) on cotton, advocating a considerably closer spacing than had previously been adopted. This closer spacing was necessitated by the shorter growing season and to diminish the ravages of pink bollworm. A trial was conducted to establish whether the new spacing outyielded the old, and results showed that the recommendation was fully justified, the closer spacing outyielding the old by 12 per cent., and giving a total yield of 1,262 lb. of seed cotton per acre. Pink bollworm was discovered towards the end of the season, but with the earlier maturity given by the closer spacing no material damage was inflicted.

Further means of control against pink bollworm consisted in the disinfection of 21,874 bags of imported seed by means of the Simon's Heater, and the fumigation of 17 ships with Zyklon B.

24. GRENADA. *Cotton Industry.* (*Rpt. on Agr. Dpt.*, 1930.) All the cotton produced is grown on Carriacou, and consists of two types interplanted, Marie Galante and a "Silk Cotton." The crop was very difficult to sell, and the types are not considered desirable to grow. Experiments have been started with a special strain of fine cotton obtained from the Agricultural Department, St. Vincent, and efforts are being made to improve by selection the local variety.

The cotton grown at present can be improved by more careful picking, ginning, and baling, which is up to a very poor standard, and measures will be taken to deal with this problem.

25. ST. KITTS-NEVIS. *Cotton Industry*, 1929-30. (*Rpt. on Agr. Dpt.*, 1930-31.) The cotton crop of St. Kitts was the largest since 1919. Nevis, however, showed a serious decrease, while Anguilla produced about the same as in the previous year. In each case the yield per acre was not satisfactory. The Government Seed Farm maintains a pure strain of cotton, and the work of selection is being continued. During the period under review the cotton crop in all the islands suffered severely from cotton leafworm, and pink bollworm was also more prevalent than it had been for some time past.

26. NEVIS. *Co-operative Marketing of Cotton.* (*W. Ind. Comm. Circ.*, xlvi., 862, 1931, p. 413.) During the regime of Mr. Wilfred M. Wigley as Administrator of St. Kitts-Nevis, a scheme was adopted for the co-operative marketing of the cotton crop in Nevis. The local Government purchased the ginnery in the island from the Fine Spinners, and announced in March that they would advance to *bona fide* small growers 5 c. for every lb. of clean Sea Island cotton delivered at warehouse in Charlestown. As a result advances were made on 160,589 lb. of seed cotton, and 89 bales of clean cotton of good quality were shipped to London in the s.s. *Ingoma* on June 19. The Government's action in making advances has been of great help to the people of Nevis, and has been much appreciated by them. The Agricultural Department retained a sufficient quantity (several tons of selected seed) for the planting of the ensuing crop.

27. ST. VINCENT. *Cotton Cultivation.* (*Rpt. on the Agr. Dpt.*, 1930.) The area under cotton in the 1930-31 season was 4,996 acres, of which 3,955 acres were under Sea Island and 1,041 under Marie Galante cotton. The reason for the increased acreage was the feeling of confidence created among growers by the success of the changed planting season. It is anticipated that the yield will be good. Planters grew large areas of green dressing crops on the land before planting cotton, which cleaned the land of weeds and added humus to it—a very much needed commodity in St. Vincent soils. It is hoped that the practice will become a regular part of estate routine. Good weather was experienced during the season, and insect pests caused very little damage to the crop.

The experimental work outlined by Dr. Harland for the Cotton Experiment Station at St. Vincent is described by Mr. S. H. Evelyn, but this work is as yet in too early a stage for results to be available.

28. *Cotton Industry.* A report received for the quarter ended September 30 stated that returns were good, the total crop amounting to 605,280 lb. of lint, which worked out at 152·3 lb. per acre. Planters and peasants destroyed all cotton plants before the close season, which began on May 15 and terminated on August 31. The past season has demonstrated that the changing of the time for planting cotton has been a success.

COTTON IN EGYPT.

29. EGYPT. *Cotton Industry.* (*Int. Rev. of Agr.*, xxii., September, 1931, p. 543.) Weather conditions appear favourable for the crop, but it is feared that yields will be low owing to the hindrance to harvesting operations caused by the poor financial condition of the farmers. Private estimates point to a reduction of 15 per cent. compared with last year's figure. Harvesting is general throughout the country, including the Sakellaridis area, but arrivals at Alexandria have been small. The Government is using all means in its power, particularly by active propaganda abroad conducted personally by its members, to increase the consumption of Egyptian cotton. In the country itself the Government has adopted the following measures: (1) The institution of a commission to examine the expenditure incurred from the time of harvesting to arrival at port of destination and to reduce such expenditure to a minimum; (2) the allocation from the General State Reserve of £E1,000,000 for the assistance of rural proprietors; (3) the concession of delayed payment of agricultural rents due for the current agricultural year 1930-31; (4) the reduction from 20 to 10 piastres of the fixed duty levied on every kantar of ginned cotton produced in Egypt (this refers only to the crop of this year).

COTTON IN THE UNITED STATES.

80. The American Cotton Situation. By W. Whittam. (*Text. Rec.*, xlix., **582**, 1931, p. 31.) A discussion of the remarkable proposal of the Federal Farm Board to plough under one-third of this year's crop. In the author's view it would be no easy matter to persuade any considerable number of the 2,000,000 cotton farmers to destroy one-third of a crop already " made," paid for in labour, seed, fertilizers, rent, taxes, etc., on the off-chance of bringing an increase in the selling price of the remainder. He is of opinion that if drastic acreage reduction next year could be assured it would do more than almost anything else to put the cotton situation on a sound basis.

81. Cotton Consumption in the United States. (*Text. Rec.*, xlix., **582**, 1931, p. 59.) While it is not yet established that the United States consumption of cotton has definitely turned upward, present indications are that it has ceased declining, and it is unquestionably on a much higher level than at this time last year, according to the New York Cotton Exchange Service.

82. American Textile Notes. By W. Whittam. (*Text. Rec.*, xlix., **582**, 1931, p. 76.) The author discusses the handicaps under which the cotton producers have to struggle. It is stated that the average income of a a cotton farmer in Eastern Carolina on the present value of his product is 35 cents a day.

83. American Cotton Crop Forecasting. By J. A. Todd. (*Text. Weekly*, **8**, 1931, p. 56. Abstr. from *Summ. of Curr. Lit.*, xi., **19**, 1931, p. 526.) A review is given of recent history of crop-reporting methods in the U.S A., and the present " boll count " system is explained. This is used to check the " crop condition " opinions sent to the Department of Agriculture by their 14,000 reporters. Similarly, the acreage reports are checked by data obtained by measuring from motor-cars the frontage of the fields to the highways. Illustrations of the improved precision in the Department's forecasts since 1924 are given.

84. A Forecast of American Cotton Prices. By W. H. Slater. (*Text. Rec.*, xlix., **581**, 1931, p. 38.) This note and the table attached contain the author's annual attempt to forecast the season's average price of futures in Liverpool from August, 1931, to August, 1932, for crops ranging from 9,000,000 to 16,000,000 bales. The table is calculated on the theory of the correlation of percentage changes between related variables. The method of using the table is described.

85. " Cotton Trade Journal " (New Orleans, U.S.A.). The International Trade Edition for 1930 of this journal contains a mass of useful material and articles dealing with cotton in the principal cotton producing and manufacturing countries of the world. Interesting articles are contributed by Sir William

Himbury on Great Britain's effort to establish cotton-growing in Africa, and by Mr. N. S. Pearse on the work of the International Federation of Master Cotton Spinners and Weavers.

36. FLORIDA. *Cotton Investigations.* (*Rpt. of Agr. Exp. Sta.*, 1930, recently received.) During the year cotton variety and breeding tests and fertilizer tests were continued, together with investigations on boll weevil control.

COTTON IN FOREIGN COUNTRIES.

37. ARGENTINA. (*Int. Rev. of Agr.*, xxii., September, 1931, p. 543.) The persistent and excessive rains of the last few months have seriously damaged the crop in the Chaco, the leading producing region, so that it is in great part lost. In the province of Corrientes, where conditions are very favourable to the crop, the Government is instituting active propaganda for the increase of acreage by means of free distribution of selected seed.

38. ASSOCIATION COTONNIÈRE COLONIALE. We have received a copy of *Bull. No.* 3, 1931. Notes are included on cotton-growing in Algeria, Haute-Volta, Sudan, Ivory Coast, Togoland, Belgian Congo, Mozambique, etc., and in addition an account is given of the cottons exhibited at the Paris Colonial Exhibition. There is also a paper by G. Carle on whether it is better to grow long or short staple cottons in Morocco.

39. LE COTON DANS L'OUBANGUI FRANÇAIS. By R. L Joly. (*Coton et Cult. Coton* , vi., **1**, 1931, p. 1.) The yield of raw cotton has increased in 1925-29 from 288 to 550 tons, but in a very variable way. The yield per hectare has oscillated between 145 and 700 kilos, with a mean of 250 to 300. In the better favoured regions *G. peruvianum*, " Tende " cotton, is mostly grown, and in the poorer regions *G. punctatum*, " Tchiki " or " Tiki " cotton, is cultivated. The bulk of the paper consists of a general discussion of cotton cultivation in Oubangui, with special reference to local conditions of climate, etc., and the more political conditions of purchase by Government, etc. The cost of cultivation of a hectare is estimated at from 445 to 600 francs (£3 12s. to £4 16s. 8d.).

40. ÉTUDE TECHNOLOGIQUE DE COTONS DE L'OUBANGUI-CHARI. (*Coton et Cult. Coton.*, v., **3**, 1930, p. 265.) Three cottons of native growth have been examined. They are derived from *G. punctatum* Guill. et Perr., a small plant of 1 m. high, with small leaves, and white flowers without petal spot. The cotton is frequently stained yellow as a result of insect attack, and contains a considerable proportion of immature hairs, probably due to faulty cultivation. Apart from these disadvantages the length of fibre and the yield are good. The tensile strength is low owing to the presence of immature hairs, but it is stated that the cottons present good characters, and under proper cultivation might prove of considerable value.

41. BOUAKE COTTONS: CHARACTERISTICS. By H. de Balsac et Roehrich. (*Coton et Cult. Coton.*, vi., **1**, 1931, p. 47. Abstr. from *Summ. of Curr. Lit.*, xi., **16**, 1931, p. 440.) A technological study of six cottons from Bouake (Ivory Coast). Of these, *G. barbadense*, *G. brasiliense*, *G. peruvianum*, and Ishan are cottons of 32 to 33 mm. The *barbadense* cotton is rather mixed, *peruvianum* and *brasiliense* somewhat better, and Ishan good. Karunganni grows to a length of 28 to 30 mm. and Garrah Hills to about 18 mm. The first four cottons have greater weights and diameters than Egyptian cottons of similar length. Ishan has a strength of 41·5 kg. per sq. mm., Garrah Hills about 29·3 kg., and the others about 35 kg. Karunganni will spin to 40's, Garrah Hills to 20's, and the other four to 50's or a little higher. Notes are given on the methods of cultivation.

42. Peruvian Cotton: Cultivation and Manufacture. (*Text. Rec.*, xlix., 581, 1931, p. 78.) It is stated that notwithstanding the fact that during the past few years larger quantities of Peruvian-grown cotton have been exported to Great Britain, the progress of the industry, in spite of intensive efforts made to encourage it, has been very slow. The most important cotton grown is Tanguis, which on account of its woolly nature lends itself admirably to admixture with wool in the manufacture of woollen goods.

On the manufacturing side, Government is endeavouring to stimulate local production, but textile imports still constitute the third most important item on the import list. It is considered that when political affairs are settled there will be opportunities for British mills to obtain orders for many lines which cannot be supplied from local sources.

SOILS AND MANURES.

43. The Waste Products of Agriculture: Their Utilization as Humus. By A. Howard and Yeshwant D. Wad (Humphrey Milford, Oxford Univ. Press, 1931, price 7s. 6d.). This is a book that marks a distinct step in advance, for it outlines a system of dealing with the miscellaneous refuse of an Indian farm which provides a large supply of finely divided humus. This forms a manure which can be easily incorporated into the soil, and which in its formation need only employ about a quarter of the available supply of cowdung. Three-quarters of the latter is therefore left to provide the fuel that is in universal use throughout India, and consequently the contention—hitherto in possession of the field—that to bring manuring to a proper state of efficiency requires the use of the whole of the cowdung (or failing that, of expensive artificial manure) is rendered nugatory.

The greater part of the book is taken up with the underlying chemical and biological foundations upon which the work is based, and with the chemistry and biology of the actual facts of the process used. The process is then described in detail, and is one that a little training should enable any intelligent man to carry out. The actual residues employed at Indore include cotton stalks (broken up by laying them on the road), sunn hemp, sugar cane trash, weeds, dead leaves, straw, damaged stalks, sugar cane stumps and the like, waste paper, shavings, old uniforms, etc. These are well mixed to bring the carbon-nitrogen ratio to approximately 33:1, and fermented in pits with the aid of the urine earth from the cattle, a quarter of the cowdung, and a proper quantity of water, with the necessary adjustments at various times to keep conditions constant. After about three months a compost is obtained which is in a state of fine division, and which is easily incorporated with the soil. Its carbon-nitrogen ratio is close to the ideal 10:1, there is little or no loss of nitrogen in its formation, and it has a very satisfactory nitrifying power. Fermentation, incidentally, is carried out at a temperature which prevents smells or the breeding of flies, and the process, consequently, should prove of great benefit in dealing with the sanitation and hygiene of tropical villages.

The process, evidently, has great affinity with that of the adco method, but has the great advantage of cheapness, and has been found on the whole to give better results in a warm climate. The book is one which must be upon the table of everyone who is concerned with soils, crops, or tropical hygiene.

44. Cotton Plant: Manuring. By V. N. Mandruigin. (*Chem. Abstr.*, 25, 1931, p. 1936. From *Udobreni i Urozhai* (*Fertilisers and Crops*), 2, 1930, p. 363. Abstr. from *Summ. of Curr. Lit.*, xi., 16, 1931, p. 440.) Trials with various nitrogenous fertilisers over a period of two years are reported. When applied at the time of planting, the best results during the year of application were from ammonium sulphate, followed by potassium nitrate, calcium cyanamide, ammonium nitrate, and urea. The best after-effects were shown by ammonium nitrate followed by ammonium sulphate, potassium nitrate, urea, and calcium cyanamide. The highest total increase in yield for the two years came from ammonium sulphate followed by ammonium nitrate, potassium nitrate, calcium cyanamide, and urea. When the same fertilisers were added during the process of boll formation, the calcium cyanamide was the most effective during the first and second years. In general, the increase in yield was higher when the fertilisers were added later in the process of growth. This is in accordance with the results of physiological experiments which show that cotton takes up more nitrogen in the later stages of growth than during the early part.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

45. Mechanical Cotton Picker. (*Queenslander*, Brisbane, July 16, 1931.) Describes a mechanical cotton picker invented by Mr. J. Ferrier of Brisbane. It is claimed that under normal conditions the machine will pick 100 per cent. of the crop, and the capacity is estimated at eight times that of a single person. A demonstration was given at Gatton College, but was not an absolute success, and alterations were made which effected a big improvement. Recently the improved machine was demonstrated to a group of interested business people, and the trial was sufficiently successful to be impressive. Mr Ferrier is at present floating a company to provide capital to construct a new machine embodying modifications and improvements which it is confidently expected by the inventor will prove successful.

46. "Carver" Ginning and Oil-Extraction Plant. By C. A. Padilla O. (*Gaceta Algodonera*, vi., 71, 1929. Abstr. from *J. of Text. Inst.*, xxii., 8, 1931, A 378.) Ginning and cleaning machinery produced by the Lummus Cotton Gin Company and oil-extraction apparatus are described.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

47. A Preliminary Report on an Investigation into the Biological Control of West Indian Insect Pests. By J. G. Myers. (*E.M.B.* 42, 1931. Pubd. H.M. Stat. Off. Price 1s. net.) It has been estimated by Dr. S. A. Neave that 10 per cent. of the effort expended upon agriculture in the Empire is stultified by the action of insect pests—in other words, the work of some 15-20,000,000 agricultural workers is devoted to feeding useless insects. It is, therefore, of the greatest importance that everything possible should be done to control these pests, and since in many parts of the Empire the cost is too great to allow of the economic use of spraying and other preventive methods, the method of biological control may be considered the most promising. In this connection the Imperial Institute of Entomology is endeavouring to build up at its parasite laboratory in Farnham Royal a staff of entomologists highly trained in the methods of biological control, whose services will be available to all parts of the Empire. The following report by Dr. J. G. Myers, embodying the results of his preliminary survey of the possibilities of biological control of the insect pests of the West Indies and adjacent colonies, represents the initial effort of the Laboratory in this direction.

In this paper the author has come to various conclusions of importance. He points out at the start that the idea that islands offer more promising fields for work is largely based on comparison of tropical islands with temperate continental areas—a comparison which is obviously unfair. At the same time, the areas devoted to many crops themselves form ecological islands on the mainland. He also insists that the study of the pest should be made in an entirely primitive environment, in a virgin plant-association, to evaluate its position and to find out, if possible, why it has become a pest.

Most of the problems that crop up in the West Indies are due to the introduction of foreign organisms, just as in Ceylon or other tropical country most of the crops, the common weeds and many of the animals, and even the insects, have been introduced from abroad. An interesting summary of the mongoose situation—the first we have seen—is made, and on the whole the verdict is against the mongoose. The biological conditions of the different colonies and islands are described in some detail, and it is pointed out that insect pests are most destructive on the furthest outlying and smaller islands, and less so in the larger ones, notably so in Haiti.

The pests themselves are then dealt with, and considered in relation to the biological conditions of the different countries. Those of sugar and cacao, as the most important, are first considered, and those of cotton follow on. A valuable historical and comparative discussion is given to pink bollworm, leafworm, stainers, and green bug. The pink bollworm, once a serious pest, has of late, from unknown causes, decreased to economic negligibility. It is thought that cotton leafworm cannot properly be attacked biologically till the focus of its migrations is discovered. Introduction of parasite enemies of stainers from Queensland or Nigeria is suggested.

References and maps conclude this valuable report, which should be in the hands of all who are interested in biological control.

48. A CHEMOTROPOMETER. By J. W. Folsom. (*J. of Econ. Ent.*, xxiv., **4**, 1931, p 827.) A simple form of chemotropic apparatus and its method of operation are described. Records of chemotropic reactions of the Mexican boll weevil, obtained with this apparatus, are given.

49. A NEW TYPE OF INSECT CAGE. By F. F. Smith. (*J. of Econ. Ent.*, xxiv., **4**, 1931, p. 914.) A description and illustration of a micro-cage devised for confining leafhoppers and certain other insects to small areas on leaves or stems of plants. The advantages claimed for this type of cage are as follows: (*a*) Isolation of individual insects for detailed records on biology. The insects were reared in these cages without apparent interference with their normal activity. (*b*) Localization of feeding of the insect. The insect may be confined to definite small areas on the stem or either surface of the leaf. The histological and symptomatic studies of the plant parts fed upon are thus facilitated. (*c*) Self-support. No weight of the cage need be borne by the plant. (*d*) Ease of manipulation and adjustment of pressure on the plant parts. (*e*) Compactness. Sixteen cages have been used at one time on a plant in a single 8-inch pot. (*f*) Small cost and ease of construction.

50. COTTON BOLL WEEVIL HAS NO HIBERNATION IN LAGUNA DISTRICT OF MEXICO. By C. S. Rude. (*J. Econ. Ent.*, xxiv., **3**, 1931, p. 761.) Evidence goes to show that the boll weevil does not have a true hibernation period in north-central Mexico. On February 17 a newly emerged adult was found in cotton bolls that had been picked the previous season. Three live pupæ were also found while cutting open dry cotton bolls on February 28, and two old weevils were taken from a flight screen in a field where cotton stubble had been ploughed under the previous month. This part of Mexico is a desert plateau about 3,700 ft. above sea level, where cotton is grown under irrigation, the annual rainfall being less than 9 ins.

51. THE WHITE-FLY OF COTTON. (*Agr. and Livestock in India*, i., **4**, 1931, p. 486.) In a letter to the Editor, Mr. W. Roberts writes that Mr. Husain's criticism* of his articles in the EMPIRE COTTON GROWING REVIEW* is eminently fair. He continues: "As regards the relative infestation of 289F and 4F, it appears that up to August 289F showed distinctly less infestation than 4F. There is some indication that early spraying is more effective than late spraying, and the July attacks might possibly affect yield more than August-September attacks. Be that as it may, we are told nothing *re* ultimate yields of the plots or plants compared. Without that the method employed means very little. In my articles I have quoted relative average yields of 4F and 289F for several years, and it is quite obvious from those figures that, whatever the cause, 289F is far more immune than 4F. Our observations during bad years such as 1928 and 1929 at Khanewal, though lacking the scientific precision of Mr. Husain, certainly indicated heavier infestation of 4F. Further, the cage experiments give strong indications, which are fully confirmed in this last season's work, regarding the vital importance of 'white-fly' as it affects yields. The 'disease' or failure of the crop is more important to me than the 'white-fly' as such, but even so Mr. Husain's and Mr. Trehan's researches go to prove more and more that 'white-fly' is the vital factor in the case.

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* *Cf.* Abstr. **455**, p. 255, Vol. VIII.

"As regards 3F in 1913, Mr. Husain is probably right in considering jassid as the main cause of failure, but the writer recalls a remark of the late Mr. Howlett during a visit to Lyallpur about 1914 in which he said that he found much more 'white-fly' about in the cotton than jassid, and he doubted whether we were always accurate in our nomenclature."

52. DAMAGE TO COTTON BY CRICKETS. By J. W. Folsom. (*J. of Econ. Ent.*, xxiv., 4, 1931, p. 807.) Much new information is here presented on the field cricket (*Gryllus assimilis*) as a cotton pest. The life history, results of observations and experiments on habits, and methods of control are given.

53. CAGE TESTS OF THE EFFECTIVENESS OF INSECTICIDAL DUSTS FOR THE CONTROL OF THE COTTON FLEA HOPPER. By K. P. Ewing. (*J. of Econ. Ent.*, xxiv., 4, 1931, p. 821.) During the summer of 1930 a new method of conducting toxicity tests for control of the cotton flea hopper (*Psallus seriatus* Reut.) was put into practice, and proved quite satisfactory. Small cages 18 by 18 by 24 ins., covered with fine-mesh brass wire cloth, and designed to rest on a stool 1 ft. high, were used. Approximately 50 insects were placed in each cage for each test. Seventeen insecticides, combinations of insecticides, or inert materials were tested as dusts for their toxic effects upon the cotton flea hopper. In making the applications, small cylindrical dust guns, approximately 2½ in. in diameter and 1 ft. long were used. The dust, at the rate of 12 lb. to the acre, was applied to the plants from outside the cage or through the screen. A total of 193 tests was completed, and there were also 56 cages in which the insects were left untreated as checks. In 122 of the test cages adults were placed on croton, in 49 nymphs were placed on croton, and in 22 adults were placed on cotton. Briefly summarized, the results were as follows: The 4 per cent. nicotine dusts proved more effective in killing adults and nymphs than the 2½ per cent. nicotine dusts. Sulphur was very much more toxic to nymphs than to adults; each of the three grades of superfine sulphur being more toxic than the flowers of sulphur. A most striking result was the high kill secured by both sodium fluosilicate and the commercial mixture of calcium arsenate and Paris green. Neither barium fluosilicate, nor pure calcium arsenate, nor any of the home-mixed Paris green combinations, showed any promise as practical insecticides for cotton flea hopper control.

54. TANGANYIKA. *Tsetse Research.* (*Tsetse Res. Ann. Rpt.*, 1930.) Describes the work in progress to control tsetse fly by means of organized grass burning, insect traps, tree poisoning, thicket barriers, and by means of parasites, etc.

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* *Cf.* articles by W. Roberts on pp. 181 and 275, Vol. VII.

55. THE IMPERIAL MYCOLOGICAL INSTITUTE. (*Trop. Agriculture*, viii., **10**, 1931, p. 276.) A good general account, copied from *The Times*, of the work of the Institute (formerly known as the Imperial Bureau of Mycology). The Bureau was founded in 1920 and has two main functions: (i.) to identify and describe specimens of fungi sent in by field workers from all over the Empire, and, if necessary, to advise on control measures; (ii.) to act as a clearing-house of information for all matters relating to plant diseases, other than those caused by insects.

56. FURTHER STUDIES ON LEAF-CURL OF COTTON IN THE SUDAN. By T. W. Kirkpatrick. (Reprinted from *Bull. of Ent. Res.*, xxii., **3**, September, 1931.) *Summary :* The reasons for adopting the name "leaf-curl" for the virus disease which is manifested by symptoms of "leaf-crinkle" on certain varieties of cotton, and by "mosaic" on certain others, are discussed. A brief review is given of the very few references in previous literature which are relevant to leaf-curl. Up to the end of February, 1931, 168 straightforward attempts had been made to transmit crinkle from Sakel cotton to Sakel by means of white-flies (*Bemisia gossypiperda* Misra and Lamba), of which no fewer than 157 were successful. No transmission was obtained with any other insects. A single white-fly can transmit the disease to a healthy plant, though infection is less regularly obtained when one or only a few white-flies are used. There is a large amount of negative evidence, which indicates that the virus is not transmitted through the seed of Sakel cotton. There is also no evidence that it can be transmitted through the soil. In nearly 200 controlled experiments the incubation period of the virus in the plant varied from eight to thirty-four days, but over two-thirds of the recorded periods was between eleven and nineteen days. Possible causes of the variation in the incubation period are discussed. Little is known with certainty about the factors which influence the severity of the disease. At least one case of complete recovery from the disease appears to have been observed; partial recovery is not infrequent. Details are given of observations and experiments made on three strains of Sakel cotton selected for resistance to crinkle. Though none of them was immune, two at least showed a high degree of comparative resistance and a greater tendency to recover than ordinary Sakel. White-flies can pick up the virus from those parts of an infected Sakel plant which show no symptoms, and transmit the disease to healthy Sakel. It is at present rather doubtful whether they can pick up the virus from a plant which has been infected but before the symptoms develop. In order to transmit the disease, it is not necessary that white-flies should have fed on crinkly plants as adults, provided that they have done so as larvæ. White-flies which have picked up the virus remain capable of transmitting it for seven days, and very probably throughout their life. Uninfected adult white-flies can pick up the virus from crinkly Sakel in just over three hours (and possibly in a shorter time). Transmission was, however, only obtained on two plants out of five, when the time available for picking up the disease was three hours and twenty minutes. When it was four hours and thirty minutes or longer, transmission was obtained in every case. Infected white-flies can transmit the disease to healthy Sakel plants in thirty minutes, and the whole process of infection of the white-flies and of the healthy plant has been accomplished in six hours thirty minutes. The virus cannot be transmitted through the egg of the white-fly. Crinkle can be transmitted by white-flies from Sakel cotton to Bamia (*Hibiscus esculentus* L.), to Til (*Hibiscus cannabinus* L.), and to Karkade (*Hibiscus sabdariffa* L.). The symptoms on these plants resemble fairly closely those on Sakel. The virus is readily transmitted back from Til to Sakel, but re-transmission from Bamia to Sakel has not yet been obtained; although transmission from Bamia to Til, and from these infected Til plants to Sakel, has been successfully accomplished. In order to infect Sakel from Bamia it therefore appears necessary to pass the virus through Til. Crinkle has also been observed on garden hollyhocks. When white-flies from crinkly Sakel are transferred to American cotton of the variety Watts Long Staple, a conspicuous mosaic is regularly produced, but none of the ordinary symptoms of crinkle appear, except occasionally the faintest traces which do not persist. Mosaic can also be readily transferred by white-flies from infected plants of Watts Long Staple to healthy plants of the same variety. Attempts to transmit it by needle have failed. No case of complete recovery from mosaic has been recorded, but partial recovery, as with crinkle on Sakel, is not uncommon. The incubation period of the mosaic manifestation of the virus in Watts Long Staple is similar to that of crinkle in Sakel. White-flies from crinkly Bamia have not produced any symptoms on Watts Long Staple, but typical mosaic is carried by white-flies from crinkly Til. When white-flies are transferred from Watts Long Staple plants with mosaic to healthy Sakel, no symptoms of either crinkle or mosaic are manifested; but it is shown that such Sakel plants harbour the virus in a masked form, since when white-flies re-transmit it from them to healthy Watts Long Staple plants, typical mosaic is produced. Minor experiments on the transmission of mosaic show that it behaves similarly to crinkle. Reasons are given for considering that crinkle and mosaic are different aspects of one virus, the symptoms of which vary according to the host-plant. Lists are given of a number of other varieties of cotton to which transmission of the virus by white-flies has been attempted. Some of these develop crinkle only, some mosaic only, a few may show the symptoms of both crinkle and mosaic in the same plant, while on some—particularly Asiatic cottons—no symptoms have been produced. There is no indication that such plants harbour the virus in a masked but transmissible form. A few minor transmission experiments are described. Possible virus diseases have been observed on lubia, French beans, and gubein (*Solanum dubium*); these, however, if virus diseases at all, seem to have no connection with leaf-curl of cotton. . . . Apart from the selection of resistant strains of cotton, the only possibilities for the control of leaf-curl lie in control of the white-flies or the control of the initial sources of infection early in the season. . . . It is believed that the virus is carried over from one season to the next mainly in the ratoon cotton plants which survive the " dead " season and produce new growth which is almost always crinkly, when the land which had been under cotton is irrigated for lubia and dura in August. It is hoped that the new rotation proposed by the Sudan Plantations Syndicate will make it possible to eradicate this ratoon cotton.

GENERAL BOTANY, BREEDING, ETC.

57. COTTON PLANT: ELECTRICAL STIMULATION. By K. A. Wysotsky. (*Bot. Centr.*, **18**, 1931, p. 331. From *Acta Univ. Asiæ Med.*, Tashkent, 1929, Ser. x., Fasc. 1, 20S. Abstr. from *Summ. of Curr. Lit.*, xi., **17**, 1931, p. 489.) The effects of changes in atmospheric electricity on the growth of cotton was studied at the Turkestan selection station. A system of wire nets was placed over the plants and electrification applied at different periods. A midday negative action produced retardation in the development of the plant, while a positive action in the evenings produced an acceleration of the development. Both actions gave an increase in the yield, the effect being greater with the positive electrification.

58. THE MEETING OF THE INTERNATIONAL ASSOCIATION OF PLANT BREEDERS, BERLIN, 1931. (Received from Imp. Bur. of Plant Genetics, Cambs.) Among the many matters of interest discussed at the meeting were the following: The breeding of wheat for rust resistance, intergeneric hybrids—with special reference to wheat and rye, " land races " of wheat, plot tests, the possibility of establishing a plant breeders' " protecting law," breeding of forest plants, etc.

59. INTERGENERIC HYBRIDS BETWEEN *Gossypium* AND *Thurberia*. By S. C. Harland and O. S. Atteck. (*Amer. Nat.*, **65**, 1931, p. 380. Abstr. from *Plant Breed. Abstrs.*, ii., **1**, 1931, p. 30.) The chromosome number of the wild Arizona cotton *Thurberia thespesioides* A. Gray is thirteen as in the Asiatic cottons. Hybrids have been obtained of it with *Gossypium stocksii*, *G. Davidsonii*, and two New World Sea Island hybrids as females. Only in the latter case were mature plants obtained. The petal spot of the *Thurberia* parent was, contrary to expectation, not dominant, suggesting that the New World parent contained two recessive genes for this character. The hybrids were all sterile. The above results warrant the inclusion of *Thurberia* in the genus *Gossypium*, and the name *G. lanceoeforme* Miers is suggested.

60. THE APPLICATION OF THE "METHOD OF MAXIMUM LIKELIHOOD" TO THE ESTIMATION OF LINKAGE. By J. B. Hutchinson. (Reprinted from *Genetics*, **14**, 1929, p. 519.) *Summary:* The "Method of Maximum Likelihood" developed by Dr. R. A. Fisher is applied to the problem of estimating linkage in cases involving complementary and duplicate factors. Variances are calculated for existing formulæ, and their efficiencies are determined to show that the "Method of Maximum Likelihood" is in all cases superior to any other method of estimation. The amount of information supplied per plant by Maximum Likelihood formulæ for F_2s and back crosses, and by other formulæ for F_2s, is calculated and compared with the amount of information supplied per plant by a simple—that is, completely classified—back cross. From Figs. 2, 3, and 4 it is possible to estimate the size of family necessary to give any required degree of accuracy.

FIBRE, YARN, SPINNING, WEAVING, ETC.

61. RESEARCH IN THE BRITISH COTTON INDUSTRY. By Dr. R. H. Pickard. (*Cotton*, M/c, xxxvii., **1789**, 1931, p. 29.) A very interesting account of the work of the Shirley Institute, dealing more especially with the various problems under investigation in the new Spinning and Weaving Departments.

62. COTTON: CHEMICAL CHARACTERISTICS. By G. Kita *et al.* (*J. Cellulose Inst. Tokyo*, **7**, 1931. Abstr. from *Summ. of Curr. Lit.*, xi., **15**, 1931, p. 431.) A table is given showing the oil contents and copper numbers of 11 different kinds of cotton, and also the iodine numbers of the raw and scoured cottons. The iodine numbers agree comparatively well with the copper numbers.

63. MICROSCOPICAL EXAMINATION OF DEFECTS IN TEXTILES. By H. Ellis. (*Text. Rec.*, xlix., **582**, p. 29, and subsequent number.) The article is intended to reveal the scope and practical uses of microscopical technique in some of the problems most frequently arising during ordinary factory routine, and thus to assist in establishing by microscopical methods the relativity of cause and effect with regard to certain defects which are constantly recurring in textile materials.

64. FIBRE AND FIBRE MARKETS. By G. E. Cookson. (*Text. Rec.*, xlix., No. **581**, 1931, and subsequent numbers.) A general and readable account of the chief fibres in use, including cotton, kapok, coir, flax, hemp, jute, ramie, and sisal.

65. STANDARDIZATION IN THE TEXTILE INDUSTRY. By Dr. A. Niemeyer. (*Text. Rec.*, xlix., **581**, 1931, p. 39.) Discusses the limitations and restrictions which stand in the way of standardization.

66. COTTON: OIL SPRAYING. Southern Textile Association. (*Cotton*, U.S., **95**, 1931, p. 638. Abstr. from *Summ. of Curr. Lit.*, xi., **15**, 1931, p. 420.) Good results have been obtained by the use of varying amounts up to 0·33 per cent. The oil keeps down floating dust so that carding and spinning rooms are much cleaner.

No effect on breaking strength has been observed, but in some cases it has been found that with oiled cotton the cards require more frequent stripping and the web contains more neps.

67. RUBBER-SPRAYED COTTON: APPLICATION. By W. Pickard and J. West. (M/c.) (E.P., 351,248 of 26/6/30. Abstr. from *Summ. of Curr. Lit.*, xi., **15**, 1931, p. 421.) It is claimed that cotton can be spun to finer counts and a stronger, fireproof yarn by spraying with a solution of rubber in naphtha, followed by spraying with water to which has been added bicarbonate of soda and sulphuric acid. It is convenient to apply one part of rubber solution to nine parts of cotton at a point in the opening machinery where the cotton is subject to an air blast. The fireproofing solution (4 oz. of bicarbonate and 1 oz. of sulphuric acid per gallon) is applied after the naphtha has evaporated, the vapour being drawn off by exhaust fans.

68. COTTON OPENING AND CLEANING MACHINES. By J. S. Bachman. (Rome, Georgia, U.S.A. E.P., 352,624 of 10/5/30. Abstr. from *Summ. of Curr. Lit.*, xi., **16**, 1931, p. 443.) Cotton cleaning machines, especially scutchers or openers, having means to set a volume of air in motion, are characterized by a "concave" of a beater or opener to which fibrous material is fed, a current of air coming through the concave (through which some of the coarser particles of foreign matter will sift), and circulating from one end to the other of the machine through means for screening out the fibrous material, including a pair of cages and means to separate the air from the fibrous material, and to direct the separated air through an equalization chamber and a conduit back to the concave, whereby always the same current of air circulates. The fibrous material goes only once through the machine and can be fed to and removed from the machine without stopping the current of air.

69. METHODS OF HAND SPINNING IN EGYPT AND THE SUDAN. By Grace M. Crowfoot. (Pubd. by County Boro. of Halifax, Bankfield Museum. Price 3s. Abstr. from *J. of Text. Inst.*, xxii., **8**, 1931, p. 136.) The author, who is well read in the subject, has travelled far and wide in the districts mentioned to obtain first-hand definite information on what might be termed the origins of spinning. It is interesting to be able to trace the gradual development of hand spinning from the simple process of twisting fibres together by the use of the fingers of both hands to the highly developed method of the suspended spindle spinning made familiar by classical pictures of Greek and Roman artists. The book is fully illustrated with photographs and drawings taken on the spot and showing the natives actually spinning in the several ways described.

70. CROMPTON AND KNOWLES LOOMS: STANDARDIZATION. By A. Palmer. (*Mech. Eng.*, **53**, 1931, p. 411. Abstr. from *Summ. of Curr. Lit.*, xi., **16**, 1931, p. 445.) An illustrated report of a lecture describing research on weaving efficiency, causes of stoppages, and so forth, that has led to the standardization of looms. In the preliminary investigations it was found that the proportion of total cloth costs attributable to weaving was 25-40 per cent., and that weaving costs could be analyzed into direct labour 53 per cent., indirect labour 12 per cent., and overhead 35 per cent. An analysis of weaving output showed that the efficiency reached was not much above 75 per cent., under the "best existing conditions," in these American mills, and that the looms were frequently idle for 15 per cent. of the working day, waiting for the weaver's attention. The lesson drawn from this was the need for a reduction in failures on the part of warp and weft, and an analysis of the causes and location of breaks was undertaken. The great majority of warp breaks were located at the healds and near the reed, at the selvedge ends. Improvements in the lay, harness, and picking motions have been effected.

Similarly, the study of weft breaks led to changes in the thread holder and bobbin give-ways of the magazine. The need for adapting the loom to a wider range of work was also realized. As a result, Crompton and Knowles loom works now make one standard frame to replace twelve patterns, and have so arranged the various parts as to be interchangeable. Thus, plain bearings can be exchanged for roller bearings and a non-automatic loom converted into an automatic loom merely by adding a magazine. It is claimed that the improvements effected have saved 34 per cent. in the cost of weaving, reduced "seconds" by 50 per cent., and increased weaving efficiency by 11 per cent.

TRADE, CO-OPERATION, ETC.

71. COTTON BALE WRAPPING CLOTH. (*Text. World*, **80**, 1931, p. 40. Abstr. from *Summ. of Curr. Lit.*, xi., **16**, 1931, p. 446.) Some notes are given on the progress made recently in the U.S.A. in the substitution of cotton for jute for baling purposes. One firm is making a 12-oz. cloth, 45 ins. wide, in plain and lock-stitch leno weaves. Another firm is offering a sacking, 42 ins. wide, 10½ to 11 oz. per yard, at a price of 13½ cents per yard (June 15). A third firm that has for years been making jute cloth is now making a cotton sacking with "just sufficient jute to serve as a binder."

72. COTTON PARACHUTES. (*Text. Rec.*, xlix., **583**, 1931, p. 40.) Practical trials of cotton parachutes carried out by the U.S. Navy Department clearly indicate that the cotton parachute closely approaches the silk parachute in performance as to rate of descent, opening time, strength, and ability to function after storage in the pack for sixty days. The cotton cloth increased the weight of the equipment by 1 lb. (from 18 to 19 lb.), an increase well within practical limits. A specification for cotton parachute cloth has been prepared, and cotton yarns suitable for this purpose are now being woven commercially in the United States.

MISCELLANEOUS.

73. THE WORLD TEXTILE CRISIS. By Dr. A. Niemeyer. (*Text. Rec.*, xlix., **583**, p. 32.) Discusses the position in Europe, the United States, and Japan.

74. LANCASHIRE AND THE FAR EAST. By Freda Utley. (G. Allen and Unwin, London, 1931. Price 16s. net.) The book is a careful study of Japanese, and to a less extent Indian, competition in the cotton industry. Miss Utley strikes the same note that has been struck in this and in many other publications: "The absurdity, or rather the tragedy, of the whole position today lies in the fact that the ability to produce more wealth leads inevitably to greater impoverishment. Society now suffers simultaneously from unemployment and from want, in a world where machinery stands idle and the primary producers can be ruined by the very abundance of Nature's harvests."

Miss Utley endeavours to show that the opinion largely held, that efficiency of labour is greater here than in Japan, and capital cost less, is an illusion, and therefore that reorganization will not be sufficient to enable us to recapture our lost markets in the East. But in this she seems to have lost sight to some extent of the well-known law of diminishing returns, which in ordinary phraseology may be put as saying that things hardly ever turn out so badly (or so well) as was expected. The gloomy condition of things that she describes among the Japanese peasantry indicates one direction at least from which may come a relaxation of the pressure.

75. THE LIVERPOOL COTTON MARKET. II. THE SPOT MARKET. By R. G. Wood. (*Trop. Agriculture*, viii., **10**, 1931, p. 274.) Deals mainly with the actual methods of sale of raw cotton.

[*Cf.* Abstr. **690**, Vol. VIII. of this Review.]

76. STAPLE LENGTHS OF WORLD COTTON CROPS. By W. W. Fetrow. (*Int. Cot. Bull.*, ix., **34**, 1931, p. 212.) In the two tables included in this report Table I. shows the estimated staple length of cotton produced in the chief cotton-growing countries of the world from 1925-26 to 1929-30; in Table II. the data in Table I. are combined to show the average annual production and percentage distribution of cotton grown in the United States and in the principal foreign countries, by staple length groups.

77. THE TEXTILE EXCHANGE. We have recently received from the Organizing Secretary a copy of a brochure giving the following particulars regarding the new Textile Exchange which is being established in London with headquarters at 1-3 St. Paul's Churchyard. The premises, when in a few weeks they are completed, will afford facilities for trade associations to hold conferences or special meetings, and for members of British and overseas firms connected with the textile industry to meet in comfortable and social conditions. There will be a select restaurant and light refreshment service, reading and writing rooms, private offices with telephones and stenographic service, lock-up stockrooms, space for exhibitions, parades and special displays, etc. There will also be an Information Bureau, particularly for visitors from overseas seeking to make contact with British firms or associations. For the benefit of students and researchers periodical meetings will be arranged during the lunch hour or early evening, in which every phase of textile industry will be discussed and ventilated by men with expert knowledge of their subject.

The subscription has been fixed on so moderate a scale (three guineas per annum for town members, and two guineas for country and overseas members) that a very large membership is necessary to justify the enterprise. Further information regarding the project can be obtained from the Organizing Secretary, Mr. Vivian Carter, The Textile Exchange, 1-3, St. Paul's Churchyard, London, E.C. 4.

78. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1931-1932. (London, Manchester, Bradford, New York, Montreal.) The price of the ninth issue of this invaluable directory of the cotton trade is only 20s. as compared with 30s. in previous years. The usual thumb-holes for easy reference to the different sections are included under the following labels: Advertisers, Exporters, Merchants and Brokers, Waste Merchants, Spinners and Manufacturers—Great Britain, including a list of directors, etc., United States, Germany, France, Italy, India, China, Japan, Other Countries—Yarns, Piece Goods, Fabrics, Rayon, Mill Supplies, Textile Machinery, Electrical, Chemicals. All the information is given in the most careful detail, and valuable additions have been made to the particulars previously published. It is stated that although every effort is made to ensure that the details given are as up-to-date as possible, the period taken for the book to go through the press precludes the insertion of much new data. With a view to surmounting this difficulty, information received too late for the directory will be published in the columns of the *Textile Weekly*, and particulars of Companies Reports, Balance Sheets, etc., will also be included in this paper. The "Mill Supplies Section" of the directory has been bound separately for the personal use of the mill managers. The "Fabrics Section" has also been bound separately for free distribution to potential buyers of cotton piece goods, and as circumstances demand other sections will be dealt with in a similar manner.

79. **Commercial Occupations.** (Publ. by the Liverpool Educ. Comm., 1931. Price 6d.) We have received a copy of this pamphlet, which is the fourth of a series issued by the Liverpool Education Committee on the subject of the employment—industrial, commercial, and professional—open to young people and adults in the Merseyside area. The main branches of commerce are dealt with separately in the pamphlet; all types of commercial work for girls are considered; statements concerning wages, pensions, holidays, and so forth have been verified by competent authorities, information is given regarding facilities for continued education in commercial subjects, and a list is included of books and periodicals recommended for use by those engaged in commerce.

ADDENDUM

80. **Uganda.** *Cotton Reports.* (*Ann Rpt of Dpt of Agr*, 1930, Pt II) From the report of the Cotton Botanist for the 1930 31 season we learn that at Bukalasa angular leafspot was widespread, but favourable weather conditions prevented the development of the blackarm stage of the disease One strain, B 31, showed complete resistance to angular leafspot, and others, including three Acala strains, showed only slight susceptibility Several lines, including B 42 and B 45, showed excellent erect habits, were storm resistant and early and quick maturers Reselections from U 4 were disappointing in showing no outstanding characters In varietal trials S G 27, S G 27.15 13, and Local were all significantly higher yielders than U 4, and definitely superior in quality Insect pests and diseases caused comparatively little damage at the Station during the season

At Serere angular leafspot was widespread as at Bukalasa, but here again favourable weather conditions prevented the development of the blackarm stage. In the breeding plot several strains showed partial resistance to angular leafspot, particularly S G 129 The U 4 selections were more promising here than at Bukalasa. The S G 29 strain was grown for the first time in general distribution, the whole of the Kadunguru gombolola and the Mulondo Seed Farm area being planted with it. The continuous planting experiment was repeated, and again showed the value of kraal manure for retaining the fertility of old plots

From the report of the Entomologist we learn that the Assistant Entomologist was engaged mainly on investigations of cotton insects, special attention being paid to the determination of causes of bud and boll shedding, to the seasonal prevalence of insects, and to the determination of the economic status of the various cotton pests. It is said that the loss of crop due solely to insect attack approximately equals the amount harvested

The Mycologist reports that during the season blackarm, *Nematospora gossypii*, and *Rhizoctona bataticola* caused much less damage than in the previous season. Some injury to cotton seedlings was caused by *Rhizoctona solani*. A peculiar disease known locally as "Kigabi" was prevalent in cotton plots in Buganda during the season The leaves of robust plants wilted and turned brown in the areas between the main veins. The leaves quickly dried up and shed, leaving the plants as bare sticks Such plants were sporadic in occurrence in the plots, not noticeably in groups, and were found in almost every cotton plot Some cases of partial recovery were noticed, but during the dry months most of the plants affected died off completely In the stems were discoloured lines in the wood, containing hyphæ of a *Fusarium* sp. Whether this fungus can be considered as the primary cause of the disease is doubtful, as inoculation of the fungus into the wood of healthy plants at ground-level gave no positive results.

PERSONAL NOTES

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

Ceylon	Mr. J. C. Haigh.
Nigeria	Mr. A. J. Findlay.
,,	Mr. O. S. Swainson.
Northern Rhodesia	Mr. W. Allan.
Tanganyika	Mr. T. C. Cairns.
,,	Mr. T. S. Jervis.
,	Mr. N. V. Rounce.

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THE IMPROVEMENT OF COTTON PRODUCTION

BY

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Late Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India and Rajputana (1924-31).

THE foundation of a new Research Institute at Indore in 1924 provided an opportunity for breaking new ground in a number of directions relating to the production of raw cotton. In the first place, the best method of applying science to crop-production could be considered. In the second place, the improvements which add materially to the yield per acre could be separated from those which merely concern minor matters. Lastly, attention could be paid to the most effective ways of getting the results obtained at an experiment station taken up by the growers. The present paper deals very briefly with all these topics.

I.—THE INSTITUTE AND ITS ORGANIZATION

To assist the reader in deciding how far the Indore experience and results can be utilized in the other cotton-growing areas of the Empire, a short account is given of the general purpose and organization of this Institute, as well as of the soil and climate of the cotton tract in which it is situated.

The Institute of Plant Industry at Indore was founded on October 24, 1924, for the following objects:

(*a*) The establishment of an agricultural research Institute for the Indian Central Cotton Committee at which fundamental investigations on cotton could be undertaken. In addition, a critical study of cotton-growing on the black soils of India, and the production of improved cottons for Central India and Rajputana, both for dry and for irrigated conditions, was included in the programme of work;

(*b*) The training of post-graduate students nominated by the Central Cotton Committee;

(*c*) The provision of an agricultural centre for the States of Central India and Rajputana, which would serve as an object-lesson for the development of this portion of India, and at which officers and cultivators, nominated by the Darbars, could be trained.

The Institute, which is incorporated under the Societies Act, is supported by an annual grant of Rs. 1,15,000 from the Indian Central Cotton Committee and by subscriptions, amounting to nearly Rs. 50,000 a year, from twenty of the States of Central India and Rajputana.* During the financial year, 1930-31, the income from all sources was Rs. 1,68,956, and the expenditure was Rs. 1,49,377. The management of the Institute is vested in a Board of Governors, seven in number, elected by the subscribers, the Director of the Institute being Secretary of the Board. At no period in the history of the undertaking has financial assistance of any kind been asked for or obtained from the Government of India, or from any of the Provincial Governments. Bearing in mind the rapid development of the Institute since 1924, and the fact that the investigations have never been held up for want of money, it is evident that agricultural research, when conducted on suitable lines, need anticipate no difficulties in obtaining all the funds it requires from the industry itself.

In 1929, when the scheme had been in operation for five years, it was decided to issue a quinquennial review in which the purpose, equipment, progress, and cost of the Institute could be set out in clear and definite form. In this way the subscribers were placed in a position to see not only what had actually been accomplished, but also to understand the nature of the problems under investigation. The first of these summaries was published in book-form by the Oxford University Press in 1929, under the title—*The Application of Science to Crop-Production, an Experiment carried out at the Institute of Plant Industry, Indore.* The work was very favourably reviewed in a number of scientific journals in the United States, Great Britain, India, Ceylon, and other countries. Its publication, therefore, not only helped to maintain liaison between the Institute and its subscribers, but also enabled workers in other countries to keep in touch with the investigations. Moreover, the royalties received by the Institute more than covered the cost of production, so that effective publicity was obtained for nothing.

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* In 1924, the following eight Central Indian States joined the scheme: Indore, Datia, Dhar, Dewas (Senior Branch), Jaora, Ratlam, Sitamau, and Narsingarh. During the last three years, the following additional twelve States of Central India and Rajputana, in order of date, agreed to support the Institute —Tonk, Bijawar, Barwani, Jhalawar, Bikaner, Rewa, Jaipur, Bundi, Partabgarh, Bagli, Orchha, and Bharatpur.

The soil conditions at Indore are typical of the extensive and well-known black cotton soil areas of Peninsular India. The details of the mechanical and chemical analyses given in Table I will remind the reader of the chief characteristics of the soil on which most of the cotton crop of India is raised.

The type of cotton cultivated on the Malwa plateau of Central India, in which Indore is situated, is known as *malvi* (a variety of *G.neglectum*, Todaro). During recent years, however, a great deterioration in the quality of the fibre of this cotton has taken place, due to admixture and crossing with *roseum* (another variety of *G. neglectum*) from the Central Provinces, a type of cotton characterized by short coarse fibre. From the grower's point of view, however, *roseum* has much to recommend it; it is a high-yielding, robust cotton with a high ginning percentage, and bolls which open widely and so facilitate picking.

TABLE I.—MECHANICAL AND CHEMICAL ANALYSES OF BLACK COTTON SOIL.

MECHANICAL.				CHEMICAL.			
Fraction.	*I.*	*II.*	*III.*	*Constituent.*	*I.*	*II.*	*III.*
Clay	42·5	45·6	38 3	Insolubles	56·10	73·80	68·70
Fine silt	19·6	21·8	17·7	Fe_2O_3	9·80	9·10	11·20
Silt..	12·5	10·8	11·3	MnO_2	—	0·10	0·30
Fine sand	7·4	4·2	6·7	CaO	6·60	0·90	1·00
Coarse sand ..	10·2	6 0	9·2	MgO	2·50	1·50	1·80
Moisture	3·3	6·4	3·0	K_2O	0·40	0·20	0·40
Loss on ignition ..	3·0	5·7	2·7	Na_2O	0 20	—	—
Calcium carbonate	1·6	6·1	1·4	P_2O_5	0·08	0·17	0·06
				CO_2	0·80	0·10	0·40
				N	0·03	0·05	0·05
				Organic combined water	9·40	7·40	5·83

The chief climatic factors at Indore will be clear from Plate I, in which the rainfall, ground-water level, temperature and humidity for the year 1928 are represented.

The cotton crop is sown on the break of the rains towards the end of June, the moment the surface soil is moist enough to germinate the seed. At first growth is rapid, but the rise of the subsoil water during the second half of the rains, combined with the gradual loss

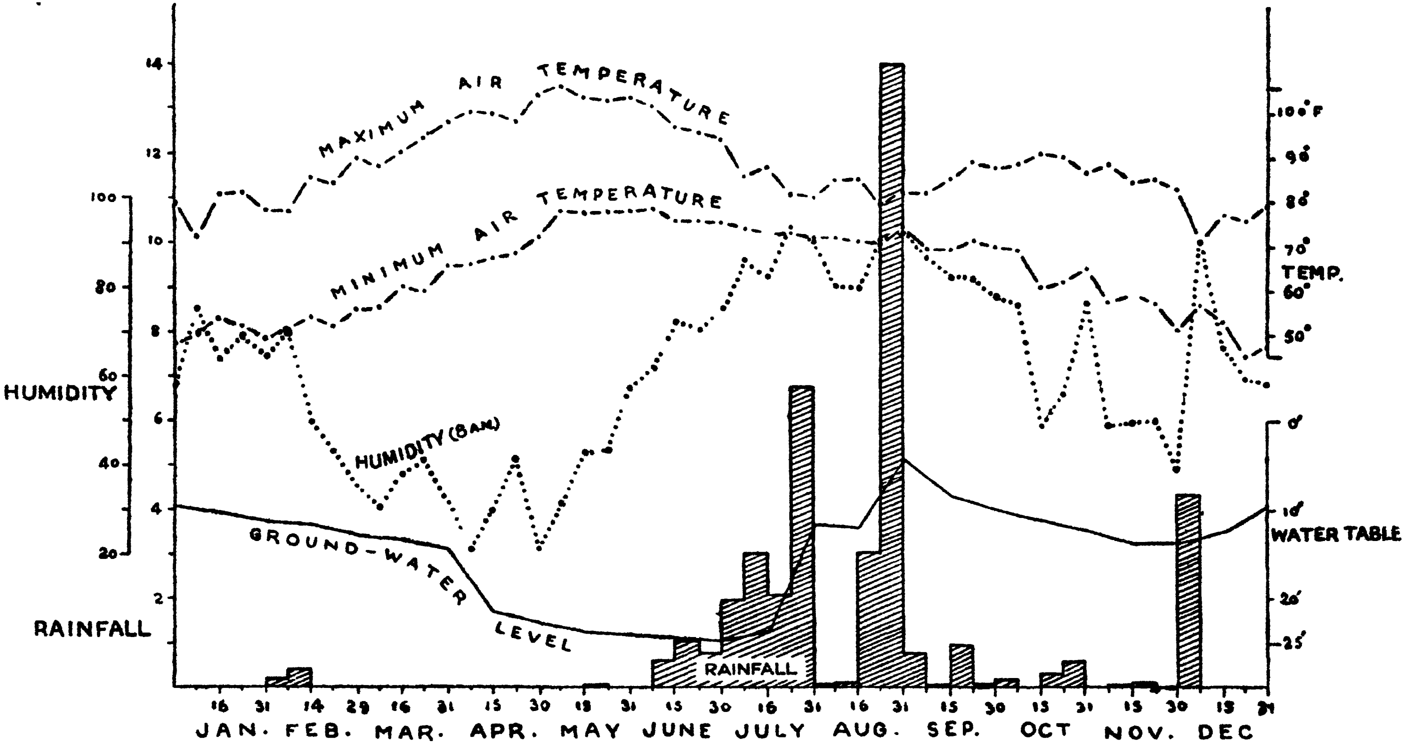

PLATE I.—RAINFALL, GROUND-WATER LEVEL, TEMPERATURE AND HUMIDITY, INDORE, CENTRAL INDIA, 1928.

of permeability of the surface soil (due to the production of colloids) as the rainy season progresses, brings about a serious dwarfing of the cotton plant. Picking begins in December, and may not be completed before the first half of February. The frosts which often occur after the New Year and the showers which fall at this period frequently cause great damage by preventing the opening of the late bolls and by discolouring the fibre. Most of the cotton grown on the black soils is raised on the natural rainfall. Irrigation is rare.

II.—THE BEST METHODS OF APPLYING SCIENCE TO THE COTTON PLANT

A survey of the development of agricultural research during the last hundred years reveals the important fact that until quite recently the approach to the practical problem has always been by one science. The researches fall into classes, each class coinciding with the limits of some well-defined branch of knowledge, like chemistry, bacteriology, entomology, or botany. The organization of agricultural workers follows closely the formal subdivision of science which exists in the colleges and universities, mainly as a convenient method of imparting information. In some instances, agricultural departments and research institutes have even assumed the position of minor universities, a number of the investigators continuing to apply academic methods of research to some fragment of a larger agricultural subject.

The result has been a much too formal and a much too rigid research organization, which is so designed that it can only bring about improvements in detail in the industry of agriculture as it exists at the moment. This no longer meets the case. Something much more comprehensive is urgently required. What is now needed are fresh approaches to the problems of production. The structure of the industry itself must be added to the subjects for investigation so that new and original means can be found to secure the economic position of the growers. To accomplish this, the organization of research must be both elastic and adaptable; as the problems change, so must the methods of attack be modified. If the approach by way of the single science no longer suffices, and if a number of problems for investigation exist which do not fall within the limits of the various subjects, some other means of bringing science to bear must be developed.

In devising the best method of applying science to the production of raw cotton, the first step is to examine cotton-growing quite apart from the existing organization of research. When this is done, it is at once evident that the plant is the centre of the subject, and that it can only be effectively studied in relation to the soil in which it grows, to the conditions of agriculture under which it is cultivated, and with reference to its economic uses. Such a problem does not fall within the limits of any of the formal subdivisions of agricultural science. The real matter for investigation for many years to come is the economic production of raw cotton, and not some detail such as the improvement of the variety, the control of some insect pest, the application of manure, or the introduction of some new cultural implement.

Is it possible effectively to study, as a whole, such a wide subject as cotton-growing and successfully to bring science to bear upon it? The answer is most emphatically yes. For the last seven years (1924-31) the production of raw cotton has been the chief subject for investigation at the Institute of Plant Industry at Indore, where the improvement of this crop has been studied as a biological whole and not piecemeal. The results obtained leave no doubt that it will not be at all difficult to re-organize cotton-growing in such a manner that not only can the grower adjust himself to the market, but the spinner will also be able to obtain, at favourable rates, an ample supply of the raw material of even better quality than is now the case. These results were obtained by following the maxim indicated above, namely, an attack on a wide front. They also suggest that the sooner the present organization of agricultural research is entirely recast the better it will be for all concerned. The manner in which all this has been accomplished is discussed in the next section of this paper.

The position of cotton-growing today is very different from what it was when bodies like the Empire Cotton Growing Corporation and the Indian Central Cotton Committee were called into being. Ten years ago the price of the raw material was high; in some cases even the supply was precarious. Today an entirely new situation has been established. Raw cotton is abundant; prices are low and are likely to remain so. The problem often is to clear the existing stocks at prices that will yield the grower a fair livelihood. How is science to help the cotton industry under such conditions? If a positive answer cannot be given to this question, the days of agricultural research are indeed numbered. The industry itself, as well as the Governments interested in cotton-growing, will soon cease to spend money on the further improvement of a product which is so abundant and so cheap that it barely pays to grow, and which, after all, meets the requirements of manufacture. The tendency will be to leave things alone and to retrench most, if not all, the expenditure now devoted to cotton research.* If, however, new methods of enabling science to help cotton-growing can be devised which will assist both the grower and the spinner, a great step forward will have been made; science will have demonstrated its usefulness as an essential factor in re-construction. Research will have ensured for itself a new lease of life. All this is possible by the introduction of intensive methods. This will enable the cultivators to raise, from a much smaller area, all the cotton which the market can absorb. The land so released can be devoted to food and other crops. In this way the economic position of the grower and of the cotton-producing areas will be improved. There will be, as at present, a money crop—cotton—for sale; the cultivators and the locality will be self-supporting as regards food; an important item on the expenditure side will disappear from the family budget.

III.—THE IMPROVEMENTS WHICH REALLY MATTER

When the cotton plant is regarded as a biological whole and considered in relation to its environment, it is at once evident that *the cotton investigations of the future must be a well-balanced combination of agronomy and genetics with soil science.* This is the principle underlying the cotton investigations at Indore. The work involved the study of the agriculture of the crop in the first instance, and the working out of simple improvements by which the weight of cotton fibre per acre could be materially increased. Modern plant-breeding methods were simultaneously applied to the local crop so that more efficient varieties could be obtained. At the same time the soil conditions were investigated so that the factors which interfere with growth could either be gradually reduced in intensity or else removed altogether. If all this is done and the results are applied all together, a long experience of crop-production suggests that no particular attention need be paid to insect and fungoid diseases. The best and indeed the only practicable method of dealing with the diseases of cotton appeared to be the cultivation of suitable varieties in an efficient manner. This agrees with the practices now adopted in sugar-cane cultivation in Java, where in late years a great change in outlook has occurred. Thirty years ago detailed studies of the insect and fungus diseases of the sugar-cane were the chief feature of the work of the sugar experiment stations of Java. These are now no longer considered necessary, as it has been found in practice that when the right variety is grown in the right way, the sugar-cane is practically immune to insect and fungoid pests. No time was therefore devoted to the study of the ordinary diseases of cotton at Indore. Subsequent experience amply justified the wisdom of this course. When properly grown, the cotton plant was found to be remarkably resistant to most forms of disease.

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* In this connection, *cf.* Abstr. No. 121 below (Ed.).

Improvements in Agronomy

The actual cultivation of cotton on the black soils of India is very defective. Great improvements are easily possible within the means possessed by any good cultivator. Three defects need immediate attention: the loss of fertility due to perennial weeds; the damage done by the uncontrolled run-off; defective methods of interculture.

Perennial Weeds.—A large area of the black cotton soils nourishes perennial grasses instead of cotton. Particularly is this the case in Central India, Bundelkhand, and the Central Provinces, where the yield is often reduced by at least a third. After very wet years, these grasses often thrive to such an extent that for many years the fields go out of cultivation altogether. Two species are largely responsible for the damage. The most injurious is *kans* (*Saccharum spontaneum*, L.), a species allied to sugar-cane, with thick underground rhizomes which grow very rapidly as soon as the rains break, and deprive the surface soil of most of its combined nitrogen. Another species—*kunda* (*Ischæmum pilosum*, Hack. Monogr.)—is exceedingly common in the areas of Central India, bordering the Central Provinces and Khandesh. The implements in use by the cultivators only keep these grasses in check; they do not eradicate them. In consequence, the cotton fields are permanently infested with perennial weeds, which always take a heavy toll of the cotton crop and, in unfavourable years, put the land out of cultivation altogether. At the moment, over a large portion of the chief cotton tract of India, *kans* is king and the cotton-grower is his subject. As *kans* was fully established all over the 300 acres of land leased to the Institute by the Indore State, some simple means of dealing with this pest had to be devised.

A study of the life-history of this species was begun in 1925, the details of which will be published shortly. At the same time attempts were made to free the area from this weed. The first trials were made with heavy, soil-inverting ploughs, but the cattle-power required was excessive and the output of work was small and unsatisfactory. The employment of the tractor and the steam-plough was out of the question, as the use of such costly implements would effectively prevent the Institute from ever obtaining any influence with the cultivators. When the cost of an implement approaches the purchase-price of a small village, the Indian cultivator argues thus: Why cultivate at all? Why not buy a village, become a landlord and live comfortably on the rents? Some simple method of eradication within the means of a well-to-do cultivator or of one of the primary co-operative credit societies had, therefore, to be devised. The solution was found in the use of an American ridging plough (from which the wings and sole had been removed) drawn by two pairs of oxen walking abreast in a single yoke. The *kans* eradicating subsoiling plough can be adjusted for depth, and is attached to the yoke by a chain 13 feet long. In this way the line of draught passes through the centre of resistance and the plough runs evenly to a maximum depth of 8 or 9 inches. The soil is lifted, not inverted, and no interference with levels takes place. A little over half an acre of *kans*-infested land can be ploughed to a depth of 8 inches in a day by one of these sets. The best results are obtained when the land is ploughed for the first time as soon as possible after the active growth of the weed begins in the early rains. As soon as fresh shoots appear, the land is cross-ploughed. Later in the rains one further ploughing is necessary. After this any weak shoots which are produced must be dug out with a pick as soon as they appear. If this procedure is carefully followed, the rhizomes still in the ground die of exhaustion before the beginning of the next rains and the field can be freed from *kans* and *kunda* in a year.

Besides eradicating perennial grasses, subsoil ploughing was found to have another beneficial effect. The growth of other weeds was markedly reduced and very clean land resulted. One of the drawbacks of cotton-growing is the encouragement of weeds, due to the fact that after flowering begins no further interculture is possible. An occasional treatment, every four or five years, with the *kans* eradicating subsoil plough, will therefore do much to remove this disadvantage.

As soon as an account of the life-history of *Saccharum spontaneum* has been published, a wall-map illustrating the various details of this pest will be prepared and issued for use in village schools, by co-operative societies and by the revenue staff of the States which contribute to the Institute.

The Control of the Monsoon Rainfall.—For at least three months before the break of the rains in June, the black soils are subjected to high temperatures and to intense drought. Wide cracks are formed and the moisture content of the upper soil is reduced to a minimum.

The early monsoon showers are entirely absorbed and there is no run-off until the surface soil is saturated. The heaviest falls frequently occur after this stage is reached. The saturated soil then ceases to absorb more moisture. The surplus rainfall begins to scour the surface and the phase of soil-erosion, accompanied by local waterlogging, ensues. As no system of surface drainage in these areas has been provided by man, the run-off prepares one for itself. The country is intersected by deep nullahs which throw out minor antennæ into almost every field, by which a large portion of the fine soil and a good deal of the organic matter are drained away. Nature's system of drainage in the black soil areas of India resembles a huge cancer, which slowly absorbs the life-blood of the countryside. The loss of fine soil and of organic matter by erosion is only one of the consequences of this want of scientific drainage. Large areas become waterlogged for long periods, denitrification takes place, and growth stops.

When the area leased from the Indore State was taken over in 1925, more than half the land was under rough grass and scrub on account of the fact that it was always too wet in the rains to be brought under plough. The portion under cultivation had suffered considerably through scour and a number of erosion nullahs were being formed. The first task was the protection of the area from the run-off which swept over it from the surrounding higher-lying areas. For this purpose, three small drainage canals, on the Italian principle, were constructed (1) to carry this drainage through, instead of over, the area, and (2) to collect the local run-off at the same time. The land was laid out in suitable fields, each of which was provided with shallow trenches (9 inches deep, 5 feet wide at the top and 2 feet wide at the bottom, with sloping sides) and grass borders to remove its own excess rainfall. In this way the area was protected from outside water, and a rough-and-ready system of local drainage was provided for each field. Wherever possible rectangular plots, each eight acres in area, were made. Between every two plots there is, in addition to the surface drain, a grass strip 8 feet wide which serves as a fair-weather road for the transport of produce and manure (Plate II).

After providing surface drainage, the grading of each individual field had to be undertaken. This was arranged for so that the run-off could reach a drain after it had travelled about 500 feet. If this distance was exceeded waterlogging took place. As the standard eight-acre plots measured 893·5 by 390 feet no difficulties were experienced when the field drained shortways. The run-off then

Plate II —Crushing Cotton Stalks by Road Traffic, also showing the Method of Surface Drainage Adopted

reached a drain before any damage was done. In cases where the plots drained longways, an artificial depression about 15 feet wide and 6 inches deep in the centre was scraped out (by means of the levellers used in grading) across the middle of the field, so as to intercept the run-off. This artificial trough, in the general surface of the field, communicated at both ends with the ordinary surface drains and served to protect the lower half of each field from the run-off of the upper half. To increase the efficiency of these depressions the soil which had to be removed in making them was arranged as a low, broad ridge on the downside of the drain. This arrangement led to no loss of land, as the depressions and the ridges were so slight that they could be cultivated and sown in the ordinary way.

Ordinary American levellers, each holding 8 cubic feet of earth and drawn by a pair of oxen, were employed for grading the surface and for preparing the cross folds and shallow ridges. The results obtained by their use have far exceeded expectation. It was found that when the work of removing the run-off is evenly distributed over the whole surface of a field of eight acres, no erosion whatsoever occurs even when a fall of 11 inches in twenty-four hours is received and when the slope is as great as 10 inches in 100 feet. One of the conditions for the formation of an erosion nullah on the black soils is the existence of depressions in the surface, towards which the run-off from all sides collects. This gives the floor of the depression far too much work to do. Loss of soil by erosion follows as a matter of course, and this, if unchecked, leads to the formation of a deep nullah with its attendant antennæ. The agricultural cancer of Central India is then established, which proceeds to feed on the natural fertility of the countryside.

Loss of fine soil and of organic matter is not the only consequence of poor surface drainage. The waterlogging of the pore-spaces of the upper layers of the soil during the rains is inevitable unless the run-off can find its way to a drain within a reasonable distance. This waterlogging, which may affect any of the various layers of the soil, is, however, not always indicated by water standing on the surface. Its occurrence, nevertheless, is promptly reported by the plant, first by a slowing down and then by a cessation of growth. The foliage begins to turn yellow, leaf-fall occurs, and growth is only resumed after the soil begins to dry and aeration again becomes possible. Not only is valuable time lost, but the loss of permeability leads to denitrification, the results of which are always apparent in the succeeding cold weather crop. Perhaps the most serious result of this waterlogging of the pore-spaces is the loss of valuable time. The period available for the growth and maturation of the cotton crop in Central India is about 180 days. Of this, at least 80 days, or over 16 per cent., is often lost, due to the absence of a system of surface drainage. This alone is more than the maximum increase in yield which could be obtained by changing the variety.

Some idea of the total loss of crop which follows poor surface drainage will be realized from a study of the figures obtained at Indore during the cotton and wheat crops of 1928-29. The rainfall of 1928 was above the average. Nearly 41 inches were received, of which 24 fell in July and 17 in August. The pore-spaces were waterlogged for a long period and the cotton crop suffered considerably. The average yields of three groups of plots are given in Table II. This may be compared with the normal yield of seed-cotton per acre (200 lb.) obtained by the cultivators round about Indore. Some figures for wheat show how the drainage of the monsoon period affects the following cold season crop.

TABLE II.—THE EFFECT OF SURFACE DRAINAGE ON THE YIELD OF SEED-COTTON AND WHEAT.

A. COTTON.

Drainage.	*Area (Acres).*	*Total Yield. (Lb.).*	*Average Yield in Lb. Per Acre.*
Very bad	13·73	1,995	145
Fair to good	46·58	17,082	366
Very good..	6·64	3,388	510

B. WHEAT.

Drainage.	*Area (Acres).*	*Total Yield. (Lb.).*	*Average Yield in Lb. Per Acre.*
Very bad	8	2,960	370
Fair to good .. .	16	9,586	600
Very good.. .. .	4	4,020	1,005

Besides increasing the yield of cotton and other crops, the provision of efficient surface drainage has proved an important factor in reducing the experimental error in variety trials and in other field tests. For some years it has been the custom to deal with the well-known experimental errors in field work by repeating the trials a number of times, and by subjecting the figures to mathematical treatment. The question arises: Is it possible, by improving the surface drainage, to reduce the experimental error and to make the land yield uniform crops? The results obtained at Indore indicate that such a result is certain. A number of plots, on which the crops were exceedingly uneven, were taken in hand and roughly graded. In a single year a marked improvement took place. Plot 1 is a good case in point. In the rains of 1927 this was sown with *san* (*Crotalaria juncea*). The height of the crop varied from 9 to 56 inches. During the cold season of 1927-28 the plot was roughly graded and then sown with ground-nuts. The unevenness was very materially reduced. After the removal of the ground-nuts, in October, 1928, the grading of the plot was improved and the surface drainage perfected. During 1929, 1930, and 1931 rapid progress towards uniformity took place. When the writer retired in 1931 this plot, which a few years previously appeared perfectly useless, was producing uniform crops which were ready for a statistical examination. Unfortunately, pressure of work prevented this task being undertaken before retirement in April, 1931.

The results obtained all over the 300 acres of land at the disposal of the Institute point to the supreme importance of good surface drainage and correct grading before any experimental work and before any variety trials are undertaken. There is no doubt that soil erosion and poor surface drainage are very important factors in the production of irregular yields on these soils, and that the improvement of the drainage followed by grading the surface will go a very long way in dealing with the experimental error.

Defective Methods of Interculture.—The interculture of cotton on the black soil areas of India is usually carried out by a simple hoe, consisting of a horizontal blade about 7 inches wide attached at both ends to a short beam. Two or three of these are drawn by a single pair of oxen, one man guiding each hoe between the rows of cotton. The defects of this hoe are (1) frequent clogging, leading to loss of time and efficiency in cleaning; (2) the weeds are not uprooted; and (3) little or nothing is done to assist surface drainage or to improve the aeration of the soil. During the rains of 1929 a simple self-cleaning ridger was devised for the interculture of cotton and other monsoon crops, and steps were taken to determine whether an increase in yield could also be expected. The most striking results were obtained with millet grown for silage, where the use of this implement led to an improvement of over 30 per cent. in the outturn. The cultivators, after seeing the ridger at work, however, did not wait for the results on cotton and other crops, but demanded an instant supply of the implement. This was arranged for with the Tata Iron and Steel Company of Jamshedpur. As fast as the new ridgers could be delivered at Indore they were purchased by the cultivators. Its spread in Central India and in Rajputana was reminiscent of the way the sewing machine has been taken up all over the world.

The Improvement of the Variety

The chief immediate problem at Indore, as regards the variety of cotton, is the isolation of a robust, rapidly maturing type from the local *malvi*, with a fibre capable of spinning at least 20s counts. In order to avoid damage by frost and rain during picking time it is essential for the improved cotton to be off the ground before the New Year. Early maturity is therefore of great importance. A subsidiary problem is to obtain, by selection from the Cambodia mixture, an early type of American cotton suitable for intensive cultivation under well irrigation. This has been accomplished; an early type of Cambodia, known as Indore No. 1, has been fixed, and arrangements made for testing it under field conditions at a number of places.

The isolation of the required type from the local *malvi* was accomplished in two stages. In the first place, a large quantity of the best seed available was required for sowing the land at the disposal of the Institute. This was obtained in 1924 from Kannod in the Nimawar District of the Holkar State, where, owing to the want of local transport arrangements between the Indore State and the Central Provinces, contamination with *roseum*, the short-stapled cotton of that locality, had not proceeded so far as in the rest of Central India. Every year this Kannod cotton was subjected to mass selection at the Institute so as to supply seed for the general sowing. The lint was sold to the local mills, and at once commanded a substantial premium over the local cotton. In consequence, the seed raised at the Experimental Station has been in great demand. It is sold for distribution to the cultivators through the Co-operative Societies. By means of this small improvement the confidence of the cultivator has been gained and a beginning has been made in the organization of schemes of seed distribution.

The second stage in the improvement of *malvi* consisted in applying the usual methods of selection. Very promising pure lines were obtained, but a difficulty arose during the fifth year which is not without interest to other improvers of this crop. From 1925 onwards all the selected plants have been raised from selfed seed. By 1930 a number of promising selections, which bred true, matured early, and possessed the desired type of fibre, were obtained. These selfed cultures have always been interspersed with rows of the ordinary mass-selected *malvi* raised from free-flowering plants in the ordinary way, and careful observations have been made to ascertain whether continual selfing in cotton leads to any falling off in vigour. In 1929 the first definite signs of this were noted.

In 1930 the pure cultures raised from selfed seed were definitely less vigorous than the ordinary crop. Arrangements have been made to continue these selfed cultures for another four or five years and to follow up the preliminary observations of 1929 and 1930 by a set of careful measurements. The indications of 1930, however, leave no doubt that continued self-fertilization in cotton leads to a serious loss of vegetative vigour. In place of the pure line, the improved cotton of the future will, in all probability, have to be raised not from one, but from a mixture of pure lines, an arrangement which will allow of sufficient crossing to occur for keeping up the vegetative vigour without, at the same time, producing any great range in the quality of the fibre. Crossing in cotton in the future will have to be controlled rather than prevented. Work on this question has been started at Indore to determine among other things (1) what range in the length and other qualities of the fibre follows the mixing of six pure lines, (2) how the progeny of such a mixture compares in vigour with the ordinary mass-selected crop on the one hand, and with the individual pure lines from which the mixture was originally made on the other. Similar investigations should be started at other places without delay. It is more than probable that the results will lead to fundamental changes in the future policy of cotton improvement.

After the possibilities of the improvement of cotton by selection have been exhausted, further progress is possible through hybridization. Before, however, this can be undertaken with success a large amount of preliminary work is needed. In India a classification on modern lines of the cotton grown in the country is essential. A large collection of species, varieties, and pure lines will have to be made, maintained and studied, and considerable progress has been made with this work at Indore. A good working collection of suitable material has been got together, and a great deal has been done to work out the details of root development and its relation to the soil and subsoil. The results already obtained on the root development of Indian cotton amply confirm the earlier observations of Balls on this subject in Egypt, and support his view that a great deal of the cotton-breeding work of the future will be subterranean and that far more attention must be given to root-development than has been the custom in the past.

Soil Factors which Limit the Yield

Two important soil factors limit the growth of the cotton plant on the black soils and seriously reduce the yield of fibre. These are:

the low content of organic matter, and the loss of permeability which occurs during the second half of the rainy season. Both these factors influence growth in much the same way—namely, by depriving the plant of an adequate supply of combined nitrogen.

The Low Content of Organic Matter.—The urgent need for more nitrifiable organic matter in the black soils is at once evident when we compare the growth of the cotton plant on the rich fields near a village with that on outlying areas which, in Central India and Rajputana, are seldom or never manured. The addition of fermented organic matter leads to rapid growth, to larger plants, to a much higher yield of seed-cotton, and to a crop which is able to withstand the heavy rainfall which so often checks the cotton plant on poor soils. No experiments are needed to demonstrate the effectiveness of more organic matter for cotton and other crops. No mathematical formulæ and no replication of small plots are required to bring the results home to the people. This work has already been done; the whole countryside demonstrates the results. What is needed is to show the cultivators where to find the organic matter and how to prepare it in the best way.

The solution of this problem has occupied the attention of the writer for many years, but it was only after taking up work at Indore in 1924 that the chemical side of the subject could adequately be explored. A method of utilizing all the waste products of agriculture and converting them into humus has been perfected. By its means, the annual crop residues and weeds of the 300 acres of land at the disposal of the Institute are transformed into about 1,000 cart loads of compost of about three times the manurial value of the same volume of ordinary farmyard manure. A detailed account of this work has recently been published, to which the reader is referred.* The raw materials employed at Indore are the following: all vegetable wastes from the cultivated area—such as weeds, cotton and other stalks, green manure, cane trash, fallen leaves and so forth, and all inedible crop residues from the threshing floor. All woody materials, like cotton and pigeon-pea stalks, are crushed by placing on the roads to be trampled and reduced by the traffic to a condition resembling broken-up wheat straw (Plate II). All green materials—such as weeds and green manures—are withered for at least two days before use or storage. All these various residues are mixed and employed as bedding for the work cattle. About a quarter of the cattle dung, the used bedding, and a certain amount of urine earth

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* Howard, A., and Wad, Y. D., *The Waste Products of Agriculture: Their Utilization as Humus*, Oxford University Press, London, 1931.

(obtained from the floor of the cattle shed) are fermented in shallow pits. Care is taken to inoculate the mass at the proper time with the necessary organisms and also to prevent excessive acidity during the process of fermentation. Matters are so arranged that the mass is supplied regularly with the necessary amount of water. The composting process is aerobic throughout. The fermentation is exceedingly vigorous, the temperatures reached are so high (65° C.) that there is no smell, and flies are prevented from breeding. The process, when properly carried out, lasts 90 days, and involves no loss of nitrogen. On the contrary, an appreciable quantity of free atmospheric nitrogen is fixed and so made available for the cotton crop. If, however, the supply of air becomes insufficient, denitrification sets in and appreciable quantities of nitrogen are lost.

The ripe compost consists of a brownish-black, finely divided powder, of which about 80 per cent. will pass through a sieve of six meshes to the linear inch. The state of division of an organic manure is an important factor, second only to its chemical composition. This property enables the Indore compost to be rapidly and easily incorporated, and to exert its maximum effort on the internal surface of the soil. The carbon-nitrogen ratio is not far from the ideal figure of 10 : 1. The nitrogen is therefore in a stable form, which does not admit of liberation beyond the absorption capacity of the crop. The percentage of total nitrogen is high, varying from 0·8 to 1·0 per cent., while the nitrifying power is very satisfactory.

Besides providing a continual supply of humus for cotton and other crops, the working out of the Indore process of humus manufacture was a contribution to the solving of a number of other problems —the principles which must be followed if green-manuring is to succeed: the fuel problem of the ordinary Indian village: the abolition of the fly nuisance combined with the improvement of rural hygiene and the general sanitation of the village.

The Loss of Permeability in Black Cotton Soil.—At the break of the monsoon and as long as the surface soil is capable of absorbing the rainfall, the general tilth of the black soils leaves nothing to be desired. The earth is mellow, friable and permeable. After about a third of the monsoon has been received, a notable change begins to take place. There is an excessive development of colloids, the soil becomes sticky, permeability slows down, and may in very wet years almost cease. The interference with soil aeration and with nitrification which follows is at once reported by the cotton plant. The growth of roots and shoots ceases, the foliage alters in colour, turns yellow, and leaf fall begins. This condition continues until a break in the rains allows the soil to dry, when aeration and nitrification are resumed. The damage done is greater when the plants are small than when they are fully grown. Further, the effect is more pronounced on poor than on rich soil. The larger and more vigorous the plant, the greater is its power of resistance. Clearly, if this development of soil colloids could be regulated or prevented, percolation and aeration would be possible and the chemical processes in the soil would proceed in the direction of nitrate formation rather than in that of nitrate destruction. The plant would obtain more food materials, and there would be a corresponding increase in yield, and in addition, valuable time would be saved.

The general directions in which this problem can be attacked are obvious. We already know that the establishment of this adverse condition is retarded by the high content of organic matter in the heavily manured soils round villages and wells. The oxidation of this organic matter involves the continuous production of carbon dioxide, which tends to increase the acidity of the soil solution—a condition which helps to flocculate colloids. It is, of course, impossible to find the manure needed to raise and to maintain the organic matter content of all the black soil areas to a point approaching that of garden land irrigated by wells. It may, however, be possible to add substances, in a finely divided state, to the soil before the rains which, after fermentation, will produce a steady stream of carbon dioxide or some weak acid. Among likely substances for this purpose, the two following have given very promising results with cotton at Indore—safflower cake and *karanj* (*Pongamia glabra* Vent.) cake. Of the two, safflower cake is the more effective for the reason that the finely divided husk ferments easily, and so produces a slow stream of carbon dioxide. Other substances which have given promising results are powdered sulphur (which in oxidation produces sulphurous and sulphuric acid) and superphosphate (which on reversion acts as a weak acid and produces carbon dioxide).

A marked improvement in the permeability of black cotton soil follows the application of compost. In this way this material acts as an indirect manure (Table III).

The property of improving the permeability of the soil which compost possesses will prove of the greatest value in keeping alkali in check, when the process is applied to the close alluvial soils of the Punjab and Sind. In regions like Egypt and the Soudan it will be equally useful.

TABLE III.—INFLUENCE OF INDORE COMPOST ON THE PERMEABILITY OF BLACK COTTON SOIL.

Period of Exposure.	*Duration of Percolation.*	*No. of c.c. of Filtrate Collected.*		*Permeability Ratio.*
		Black Cotton Soil Only.	*Compost from Mixed Residues.*	
3 weeks	2 hours	132	225	1 : 1·7
4 weeks	1·5 hours	97	164	1 : 1·7
	6 hours	195	340	1 : 1·7

In the first quinquennial review of the work of the Indore Institute the conclusion was reached that *the cotton work of the future must be a well-balanced combination of agronomy and genetics with soil science.* If this is so, then this principle should derive support when the figures of the yields of seed-cotton obtained on the plots of the Institute (on which the new system has been gradually put into practice) are compared with the standard yield on the cultivators' fields in the neighbourhood. As stated above, this latter is 200 lb. of seed-cotton per acre. The yields obtained with the mass-selected *malvi* on the fields of the Institute are given in Table IV.

TABLE IV.—THE YIELD OF SEED-COTTON AT THE INSTITUTE OF PLANT INDUSTRY, 1927-29.

Year.	*Area Under Cotton in Acres.*	*Average Yield in lb. per Acre.*	*Rainfall in Inches.*
1927 ..	53·4	328	27·79 (distribution good)
1928 ..	66·9	394	40·98 (a year of excessive rainfall)
1929 ..	93·6	446	23·11 (distribution poor)

It will be seen that there is a progressive increase in the yield and that the standard out-turn of the cultivators has been left far behind. The most significant figures, however, are obtained if we compare the yields of the group of plots on which all the improvements referred to above have been carried out in each of these three seasons, and also those of the best plot of each year. The results are given in Table V.

TABLE V.—THE INCREASE IN GENERAL FERTILITY AT INDORE.

Year.	*Area of Improved Land Under Cotton.*	*Average Yield in lb. per Acre.*	*Yield of the Best Plot of the Year in lb. per Acre.*
1927 ..	20·60	340	384
1928 ..	6·64	510	515
1929 ..	36·98	578	752

The figures show that, no matter what the amount and distribution of the rainfall may be, the fertility of the Institute lands is rapidly rising, and that in three years the average yield of an area nearly 100 acres in size is already more than twice the average of the locality.

(*To be continued.*)

SOME DISEASES OF COTTON IN SOUTHERN RHODESIA

BY

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COTTON in Southern Rhodesia appears able to resist many of the diseases to which it succumbs in other countries. This is partly due to the moderate temperatures and rainfall experienced, and partly to the somewhat scattered cultivation, with long distances between one crop and another, which militate against the appearance in epidemic form of any particular disease. Given suitable climatic conditions and suitable methods of dissemination, however, certain diseases are capable of establishing themselves throughout the colony and of causing serious injury to a crop. Thus, angular leaf spot and boll rot, caused by *Bacterium malvacearum* which is carried on (or, as some workers believe, in) the seed, can be seen in almost any cotton field, whilst certain leaf spots, particularly that caused by *Phyllosticta gossypina*, are also widely distributed as a result, presumably, of the almost universal presence of spores of the fungus. At the present time, however, there are few diseases which seriously hamper the cultivation of cotton in the colony. No extensive investigations have as yet engaged the writer's attention, but as the result of five years' field observation and laboratory examination it is considered that sufficient information has been collected to warrant the publication of this article.

DESCRIPTION OF DISEASES

1. ANGULAR LEAF SPOT (*Bacterium malvacearum*, E. F. Sm.).—This disease, which appears to be of world-wide distribution, exhibits the same symptoms in Rhodesia as are well known elsewhere. Small, angular, watersoaked spots appear on the leaves of the plant when it is a few weeks old and soon turn dark green or purple in colour, finally drying out to medium or dark brown, brittle lesions. The spots are characteristically situated close to the veins, by which they are bounded, but frequently infection of the vein itself occurs, resulting in the well-known dark streaks. Usually, infection of the cotyledon takes place, when the spots appear as relatively large, dark green, shiny blotches, which are often invaded by fungi, and the cotyledon

is rapidly destroyed. Such early attack may give to the young plant a severe check from which it recovers with difficulty, and the effects may be observed during later development. The short growing season in Southern Rhodesia makes it imperative that every assistance be given to the plant to make maximum growth early in the season, so that disease which inhibits in any way the development of the young seedlings is an important factor in local cotton cultivation.

As the plant continues to develop, bacterial leaf spotting becomes more prominent, especially, as usually happens, when fungus parasites invade the lesions. In advanced cases of this kind the small angular spots may be enlarged to coalescent blotches which involve most of the lamina of the leaf and eventually become torn to shreds by the action of wind and rain. Examination of many such leaves has revealed the presence upon the dead tissue of the following fungi: *Alternaria macrospora*, Zimmerm., which is known to be parasitic in Nigeria [1], the West Indies, and Uganda; *Alternaria gossypina* (Thüm.), Hopkins, comb. nov., which has been shown to be parasitic in Southern Rhodesia [2]; *Phyllosticta gossypina*, Ell. and Mart., a common leaf parasite, and a species of *Mycosphœrella* differing from *M. gossypina* (Cke.), Atk., in the larger size of its ascospores.

Bacterial boll rot is also of common occurrence and appears to have been confused in the past with anthracnose (*Glomerella gossypii*, Edgert.), the incipient stages of which disease it resembles closely. The dark, shiny, watersoaked spots which appear upon the boll are characteristic of *B. malvacearum* infection, bacteria being easily demonstrated in the affected tissues. The spots soon become dark and sunken, but extensive infection of the boll wall does not take place until secondary organisms make their appearance. Observations indicate that, as is usual with boll rots, the advanced stages present a complicated state of multiple infection by both bacteria and fungi, in particular *Alternaria gossypina*, *Epicoccum purpurascens*, Ehrenb., several species of *Fusarium*, *Rhizopus stolonifer*, Ehrenb. (=*R. nigricans*, Ehrenb.), and a yellow bacterium closely related to a parasitic form designated 0·1, and described from Trinidad by the writer [3]. Other species of *Alternaria*, of the *A. tenuis* Nees group, and of *Epicoccum* are also found in early association with *B. malvacearum* lesions on the boll, but appear to be entirely saprophytic.

The dark brown staining of lint which results from bacterial boll rot is indistinguishable by macroscopic examination from that caused by the internal boll disease associated with *Dysdercus* spp., and there is little doubt that some of the damage attributed to insect attack is in reality due to bacterial infection. In common with many diseases of cultivated crops, the damage caused by fungi and bacteria is laid at the door of some unoffending insect, and, in the case of cotton, the one magic word " bollworm " is the farmers' complete explanation of almost every pathological condition. Although there is good reason to look upon bollworms as the principal cause of the destruction of bolls, yet the fact must not be overlooked that *B. malvacearum* is a factor to be contended with in the production of cotton in Southern Rhodesia. Fortunately, the more serious " black arm " phase of the disease does not flourish under local conditions, although infection of stems takes place in some instances. Small lesions upon lateral branches have yielded *B. malvacearum* in culture, but no case of severe infection has come before the writer's notice. It seems possible that, in selecting jassid-proof strains of cotton suitable for cultivation under the relatively dry conditions of the colony, the staff of the Empire Cotton Growing Corporation, working at Gatooma, are also establishing strains resistant to " black arm." Although it is hoped that this possibility may be the case, yet it is considered advisable to investigate control measures, which may be called into practice should future events warrant them. It has been shown in this colony that *B. malvacearum* is carried with the seed, and it appears that the proportion of infected seed becomes greater in commercial samples as these become farther and farther removed from the original seed issued from the Gatooma Cotton Station. It is therefore evident that treatment of seed with some suitable bactericide constitutes the first line of attack upon the parasite. Sulphuric acid has long been recommended in this connection, but the cost of treatment in Rhodesia renders the method impracticable, and organic mercury compounds are now being tested in the field. It is, however, too early in the season for any results to be recorded.

Field control measures present a difficult problem should the disease become firmly established in cotton-growing areas, for it has been shown in the Sudan [4] that the disease can tide over from one year to the next in pieces of trash which drop from the plant and do not rot down before the following planting season. In Rhodesia, with its six or seven months of dry weather, there is little chance of infected leaves and bolls becoming rapidly disintegrated, especially as the cotton is not reaped until well after the last rains have fallen, so that rotation of crops will become an increasingly important operation when cotton cultivation becomes more general. It appears to the writer that the establishment of disease control measures in the early days of an agricultural industry will eventually become a matter of routine, in the same way that ploughing and cultivation have become part and parcel of farm routine.

2. INTERNAL BOLL DISEASE (*Nematospora coryli*, Pegl.).—The second widely distributed disease is that which causes an internal rot of bolls with its attendant inhibition of opening of the carpels. The disease in Rhodesia exhibits all the characteristics by which it is known in other parts of the world, but, so far, only one fungus, *Nematospora coryli*, Pegl., has been found in association. In the Union of South Africa both *N. coryli* and *N. gossypium*, Ashby and Nowell [5], have been shown to be the causal agents, whilst in East Africa the latter is known to occur; a fuller investigation locally of the organisms concerned may well show both fungi to be present. That *Nematospora* is the principal parasite causing the internal boll disease seems clear (although actual infection experiments with pure cultures have not been carried out), for the fungus has been isolated, free from contamination, from minute watersoaked spots on the young seeds and from small yellow-stained areas of lint immediately below insect punctures in the boll walls. At other times sporangia and spores of *N. coryli* have been demonstrated in similarly stained lint. Workers in the West Indies [6], the Union of South Africa [5], and elsewhere have proved the association between internal boll disease and certain plant bugs or " stainers," and field observations in Rhodesia indicate that similar conditions exist here, particularly in respect of species of *Dysdercus*. Peat [7] has shown at Gatooma that " stainers " commence to make their appearance in the cotton fields about the end of February or the beginning of March and that their population increases rapidly from this time onwards. A corresponding increase in the amount of internal boll disease does not, however, take place, although the number of bug punctures in the bolls is very great. It so happens that the influx of " stainers " coincides, as a rule, with the commencement of the dry season, and it is thought that the less humid conditions then existing inhibit the development of the fungus. If this be true, then it appears that " stainers " do not invariably carry the plant parasite internally, since if once inoculated into the boll the fungus would be little affected by the changing climatic conditions; but it is found that a large number of the bug punctures do not result in boll infection, so that presumably the inoculum is absent from the insects' mouth parts and is not in a living condition on the exterior of the boll adjacent to the point of entry of the proboscis.

The damage done by internal boll disease is not solely confined to destruction of the contents of the unopened boll. After the carpels have split and the ripened seed and lint is exposed, large numbers of

Dysdercus spp. and the dusty bug (*Oxycarenus* spp.) may be observed feeding on the seed, which remains upon the plant for weeks before being picked. During this time considerable infection of seed by *Nematospora coryli* takes place and germination may be adversely affected. Examination of a representative sample of seed shows a relatively high percentage of *Nematospora* infection, although a good number of obvious insect punctures appear to be sterile. The cotton-grower is therefore faced with the two alternatives of either having the germinating capacity of his seed lowered by exposure to fungus infection or else having to pay for the extra cost of labour in reaping his crop in several pickings. Under present conditions there appears to be little doubt that the existing system of harvesting the entire crop in one picking, late in the dry season, is the most economical, although it is difficult to assess the losses attendant upon poor germination under conditions where every day is of value during the early growing period. Low germination can, of course, be compensated for to a large extent by planting a greater quantity of seed, but it is a well-known fact that crowded seedlings do not make optimum growth, are susceptible to "sore shin," and receive a rather severe check in their development when thinning out takes place. From whatever angle the position is viewed, therefore, it is seen that *Nematospora* transmits its effects beyond the actual boll-rotting stage.

3. OTHER BOLL ROTS.—A number of minor boll rots have been encountered, but only one appears to be of much economic importance, although a closer study might well show certain organisms, which are now regarded as lesser parasites, to be more intimately concerned with rotting of very young bolls. Taking the various organisms in order of their recorded prevalence, there is first of all:

(*a*) *Rhizopus stolonifer*, Ehrenb. (=*R. nigricans* Ehrenb.).—This rot of bolls is characterized in the early stages of infection by an olive-green discoloration of the carpels, which later turns reddish brown as the carpels shrink and partially open. The lint is usually stained grey, and sometimes a yellow discoloration of the decaying seeds may be observed. The symptoms in Rhodesia show an uncommonly close similarity to those described and figured by Shapovalov [8] in the United States of America. The *Rhizopus* rot is frequently found in association with *B. malvacearum* and other organisms, and its pathogenicity has not been established locally, but from plants examined in the field there is sufficient evidence to indicate the destructive nature of the fungus, be it the causal agent or only a wound parasite. Furthermore, its influence is not limited to a rotting of bolls, for it is to be found in almost any sample of seed examined, and germination tests made in germinators and in pots have shown it to be the cause of much rotting of seed and of "sore shin," if soil moisture is excessive. The fungus has also been found causing the death of seedlings in the field under normal conditions of rainfall and temperature; up to the present, however, no severe case of seedling blight due to this organism has been recorded.

(*b*) *Epicoccum purpurascens,* Ehrenb.—A sample of diseased lint which was stained a bright, canary yellow colour was received from Gatooma some three years ago. Single hairs taken from the centre of the sample and plated out on corn-meal agar gave in several instances pure cultures of an *Epicoccum,* which has been identified by Mr. Mason, of the Imperial Mycological Institute, as *E. purpurascens,* Ehrenb., although differing slightly in cultural characters from the European form of that fungus. It appears to be identical with a strain isolated from citrus in the Union of South Africa by Miss Bottomley.*

Infection experiments carried out in this laboratory showed the Rhodesian fungus to be a virulent wound parasite of young bolls, but incapable of penetrating the carpel unaided. Since then, the fungus has been found in association with bacterial boll disease, where it appears to grow ahead of the bacteria, producing a rapid rot of the developing seeds. It also attacks the internal tissues of the boll wall, which become bright yellow in colour before turning the usual yellowish brown associated with internal rots. *Epicoccum purpurascens* has been found inside the young capsules of shrivelled "squares" which remained attached to the plant in the same way as those attacked by bollworm, but no trace of insect damage could be detected. A similar condition was produced experimentally upon growing bolls which had been pricked by a needle, but negative results only were obtained with unwounded bolls.

During the last two seasons this *Epicoccum* has been seen in company with several other fungi and bacteria in numbers of rotted bolls, and it appears to be a fairly common wound parasite in the cotton fields.

(*c*) *Bacterium* 823.—Of the minor boll rots, there is one of bacterial origin which has been seen on a few occasions and which presents several interesting features. The causal organism has not, as far as the writer is aware, been described in literature, and only a brief reference to it is possible in the present article. The parasite, which will be referred to by its serial number 823, is a short, motile rod, producing white, glistening, entire colonies on nutrient agar, digests potato, has an alkaline reaction to litmus milk, which is peptonized, produces no acid or gas with carbohydrates, no indol, and does not liquefy gelatine nor reduce nitrates. It has a close affinity to *B. mori* (Boyer and Lambert), E. F. Sm., and is quite distinct from the organism called Y3 which the writer described from Trinidad [3].

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* Private communication.

Bacterium 823 was obtained in pure culture from the base of the placenta of a boll showing a soft brown, internal rot of lint and seed and a brown discoloration of the placenta itself. When inoculated into healthy, growing bolls by means of a hypodermic syringe, a similar rot was produced, but without the distinct browning of the placental tissues. This suggested that the bacterium may have gained entrance to the boll from the tip by way of the sutures, since the diseased bolls which were examined had irregularly developed carpels, forming relatively deep cavities at the apex. The characteristically upright habit of the young bolls of U.4 cotton would allow of moisture remaining in the cavities for some considerable time, thus facilitating the entrance of weakly parasitic organisms incapable of penetrating the boll unaided. Experiments carried out with young picked bolls placed in tubes of aerated water and covered with bell-jars demonstrated this method of penetration, a typical rot commencing in the upper part of the lint, adjacent to the placenta, within five days. Field experiments were not undertaken, but it is not considered that internal boll rotting caused by *Bacterium* 823 would occur except during prolonged periods of wet weather or, possibly, heavy dews.

4. LEAF SPOT AND BOLL ROT (*Alternaria gossypina* [Thüm.], Hopkins).—This disease, which has been fully described recently by the writer [2], is found throughout the colony, the leaf-spotting phase being of common occurrence. Soon after young cotton plants appear above ground the cotyledons become attacked by various organisms, causing small, circular, purple spots, which later develop a light brown, dead area in the centre of each; if surface-sterilized and placed in a damp chamber for a few days these lesions frequently produce vigorous growths of *Alternaria gossypina*. Unless associated with other organisms, particularly *Bacterium malvacearum*, the *Alternaria* cotyledon spot does not cause any noticeable damage to the plant, but when infection of the later leaves takes place a relatively severe spotting may eventuate. During periods of drought, a certain amount of defoliation may even result from the attack of this disease. Where angular spot is prevalent, the lesions caused by bacteria may be greatly enlarged by *Alternaria gossypina*,

so as markedly to reduce the photosynthetic area of the plant, but such severe damage is not often encountered. Experiments have shown the fungus to be capable of causing an internal rot of bolls closely resembling that caused by *Epicoccum purpurascens* locally and by *Alternaria macrospora* [1] in Nigeria; and *Alternaria gossypina* has on a number of occasions been found invading the interiors of the young capsules of shrivelled "squares" which remain upon the plant. Infection of more fully developed bolls only takes place through a wound, and does not appear to be of great significance. The sooty deposit of spores, which develops upon mature lint when this has been exposed to late rains, is, however, of some importance inasmuch as an appreciable proportion of fibre may be adversely affected both in colour and strength.

Although it attacks the cotyledons soon after germination, *Alternaria gossypina* does not appear to be carried with the seed, for the amount of spotting is no less upon plants raised from sulphuric acid-treated seed than upon those from untreated. It is well, therefore, that the severity of attack by this fungus is not such as to render necessary the introduction of control measures.

5. Other Leaf Spots.—Two other fungi are to be found in any cotton field in Rhodesia. These are *Alternaria macrospora,* Zimmerm., and *Phyllosticta gossypina,* Ell. and Mart. In the initial stages of infection it is not possible to distinguish, either macroscopically or microscopically, between the leaf spots produced by these two fungi and by *Alternaria gossypina;* in many cases all three organisms may be found parasitizing the same leaf or cotyledon. In its later development, *Phyllosticta gossypina* may be identified by the appearance of minute black specks, the pycnidia, in the central dead areas of the lesions, but differentiation between the two species of *Alternaria* can only be made with the aid of a microscope.

The etiology of these two diseases is the same as that of *Alternaria gossypina,* especially in relation to combined infection with *Bacterium malvacearum,* except that no boll-rot phase has been demonstrated locally for either.

6. "Sore Shin" (*Rhizoctonia solani,* Kühn.).—The seedling blight of cotton generally known as "sore shin" has been attributed in most parts of the world to *Rhizoctonia solani,* Kühn., as well as to other organisms. In Rhodesia the fungus is present in all soils and is the principal cause of "damping-off" in many plants other than cotton. It becomes actively parasitic under conditions of excessive soil moisture, when plants do not make rapid growth, and losses in stand may result from attack by the fungus during prolonged cool,

wet weather. According to Balls [9], fungus attack is inhibited by high temperatures, and this phenomenon seems to hold good under local conditions, for the disease is rarely found during the hot weather of the early part of the cotton season.

Infection starts in the outer tissues of the stem at or about soil level, and a soft rot of the cortex takes place, which can be seen as a dark, greenish-brown, sunken lesion extending upwards from the "collar." Under favourable conditions for fungus growth, the initial lesion may be enlarged laterally until the stem is completely girded, when the young plant rapidly wilts and dies. Under conditions less favourable for the parasitism of *Rhizoctonia*, such as hot, dry weather, the development of "sore shin" is rapidly arrested, and even though penetration may have been accomplished, the plants form a protective layer of brown cork tissue which effectively arrests the further progress of the fungus. An examination of young plants in the field will show many of them to have been subjected to fungus attack, but mortality is low unless exceptionally cold, wet weather is experienced.

7. MISCELLANEOUS DISEASES.—Many organisms have at various times been observed in association with different diseased parts of cotton plants, but there is no evidence at the present time to suggest that they are parasitic.

If unseasonable late rains occur after the cotton crop has matured and the majority of bolls have opened, then it is usual to find part of the exposed lint affected by moulds, which cause blackish or grey discolorations. In particular, species of *Alternaria*, of the *Alternaria tenuis* group, and an *Acremoniella* sp., which appears to be identical with one observed under similar conditions by the writer when in Uganda,* are very prevalent. Occasionally a *Diplodia* sp. has been seen causing a black staining of lint, whilst a *Cladosporium* (probably *C. herbarum* [Pers.], Link.) frequently grows upon the honey-dew from aphides when this is washed by rain into the open bolls.

Of stem and root diseases, little is on record. On one occasion plants were observed which had longitudinal lesions upon the stems similar to those of "black arm," but *Bacterium malvacearum* was not isolated; a species of *Pestalozzina* was the only organism detected, this being, apparently, the first record of the genus on cotton. A wilt of Indian cotton, which was being grown experimentally at Gatooma, has been observed, and a *Fusarium* sp. was shown to be present in the vascular tissues of the roots, but the fungus was not identical with the serious wilt organism *F. vasinfectum*, Atk. which is present in the Union of South Africa, and is incapable of attacking the varieties of cotton which are being raised for local cultivation. Its economic position is, therefore, of little importance at the moment.

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* Unpublished.

Anthracnose due to *Glomerella gossypii*, Edgert., has been recorded [10] from the colony and is a common parasite in the Union, but so far the disease has not come before the writer's notice. It seems likely, therefore, that the seed of the U.4 strains which have been raised within the past few years, has so far escaped infection, and it is to be hoped that the introduction of a suitable method of seed treatment will prevent the establishment and spread of yet another pilferer of the farmers' hardly-earned gains.

REFERENCES.

[1] Jones, G. H. " An Alternaria Disease of the Cotton Plant." *Ann. Bot.*, vols. xlii., clxviii., 1928.

[2] Hopkins, J. C. F. " *Alternaria gossypina* (Thüm.), comb. nov., Causing a Leaf Spot and Boll Rot of Cotton." *Trans. Brit. Myc. Soc.*, vol. xvi., 2 and 3, 1931.

[3] Hopkins, J. C. F. " An Introductory Note on Two Bacteria Causing an Internal Rot of Cotton Bolls." *Ann. App. Biol.*, vol. xiii., 2, 1926.

[4] Massey, R. E. " Studies on Black Arm Disease of Cotton—II." Empire Cotton Growing Review, Vol. VIII., 3, 1931.

[5] Moore, Enid S. " Report of Cotton Insect and Disease Investigations, Pt. I." *Union of South Africa Dept. Agric. Sci., Bull.* 94, 1930.

[6] Nowell, W. " Internal Disease of Cotton Bolls in the West Indies." *West. Ind. Bull.*, vol. xvi., 3, 1917.

[7] Peat, J. E. " Reports received from Experiment Stations, 1929-30." Empire Cotton Growing Corporation, London, 1931.

[8] Shapovalov, M. " *Aspergillus Niger* and *Rhizopus Nigricans* Boll Rots." *Journ Agric. Res.*, vol. xxxv., 4, 1927.

[9] Balls, W. L. " The Cotton Plant in Egypt." Macmillan, London, 1919.

[10] Eyles, F. " Diseases of Cotton in Southern Rhodesia—Preliminary Notes." *Rhod. Agric. Journ.*, vol. xxi., 10, 1924.

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THE PURITY CHEQUER IN COTTON-BREEDING

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THE use of a target diagram, plotting the measurements of single plants for any two pairs of characters, as a test for the purity of a cotton variety, was first described by Dr. Balls in " The Cotton Plant in Egypt " [1]. The plotting of any hundred plants for, say, halo-length and ginning out-turn allows the obvious off-types to be eliminated, but cannot give any measure of the purity of the variety, as there is no means of knowing how much spread to allow for the environmental range. The method is therefore best used to make comparisons between different strains of the same variety grown together in a chequer. The use of this device [2], known as a Purity Chequer, has been resumed at Giza, with refinements in the technique, and in the last year or two it has shown such possibilities that it may now perhaps be described as the mainstay of the work being done on cotton. Some notes on the methods used may therefore be of interest to workers in other countries.

As a comparison of purity between different varieties, the method has only a limited value. To put several varieties, which are ordinarily grown in different districts, into one chequer means that some at least of the varieties are growing out of their district and may not grow normally. There is also, of course, no guarantee, even when each variety at its purest is grown under its optimum conditions, that different varieties will show the same environmental spread for any character. In comparing different strains of the same variety, however, whether or not the chequer is done in the optimum district, such reactions may fairly be assumed to be similar.

As at present used at Giza, comparisons are made, for each variety, between the bulk stock as propagated and one or more single-plant lines which are destined to be used as replacement stocks.* The layout of the chequer is very simple, ten plants of each strain being grown in a row, and the series repeated ten times, making a hundred plants of each strain. The plants are equally spaced, an endeavour is made by sand-sowing to get a perfect stand, and such spacing and cultivation conditions are used as will give the maximum yield. This will, of course, vary for different countries and cotton types. Only material from a short picking [3] is used for the comparison—that is to say, a mixed pick is taken off all the plants at an early date and discarded, and from ten to fifteen days later the individual pickings are taken. Each plant is identified by numbering the plants in each row one to ten, and giving letters to the ten rows of each strain.

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* Such single-plant lines were at first assumed to be identical with the original pure-line stock, but in actual experience we have found that the delicate technique of the Purity Chequer reveals segregations which no ordinary botanical examination could detect. These segregations become more evident when the modifying effect of other characters is eliminated during further purification of the " pure-line."

Any convenient characters may be measured. Those at present in use at Giza are the halo-length, ginning out-turn, weight of a hundred seeds, and weight of seed-cotton per boll. From these four characters six targets may be made, though only four are now being used, the boll-weight to ginning out-turn and halo-length to seed-weight being omitted. The method of plotting is simply to make a correlation diagram of the two characters on squared paper. Recently Dr. Balls has suggested the use of paper ruled logarithmically. This has now been tried and found to give better comparative targets. It shows, of course, equal percentage changes instead of equal changes as equal distances on the diagram. Thus a millimetre increase of halo on a 20 millimetre variety is shown at the same distance from the type as a 1½ millimetre increase on a 30 millimetre mean. If all characters had the same percentage environmental range when genetically pure, and were determined by methods having the same probable error, this would show the type-group as having a circular form, and in fact this is closely approached for the purer strains. Some targets of Ashmouni and Sakel plotted by this method are here shown (Fig. I).

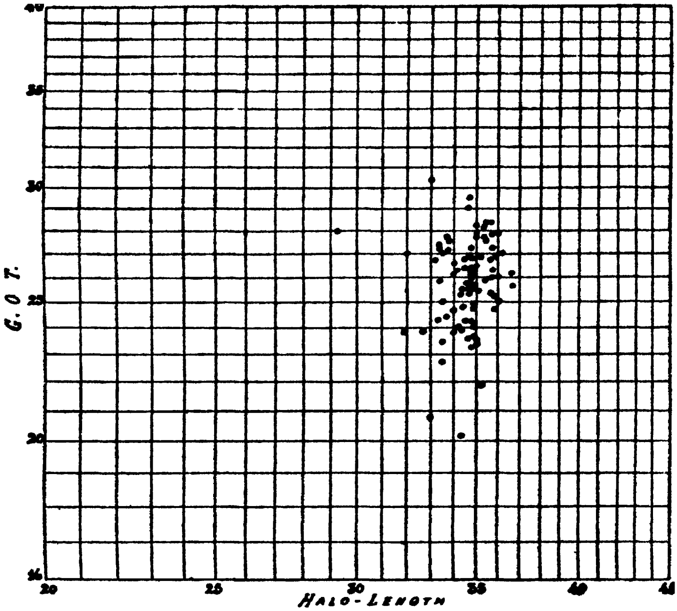
It is, of course, a commonplace of cotton-breeding that no variety can be obtained completely pure on a large scale, and only with considerable difficulty on a small scale. It is, however, of great interest to see how each character, when examined by a careful enough technique, shows impurities which are not detectable on a rough examination. In the case of a comparison such as that previously mentioned, between the bulk of a strain and several selfed stocks of single-plant origin, the selections practically always show an increase in purity over the bulk for all characters. A deviation in the mean of some of them from that of the bulk is, however, often found. In this case the method at present followed is to choose as the replacement stock one that has the same mean as the bulk, but is purer. Stocks with means for any character that deviate in a desirable direction—for example, higher boll-weight or ginning out-turn—are then made the basis of fresh selections. The idea here is that the new selection will then be compared out in all possible ways with the type selection. If the difference is distinct and desirable the new selection may be propagated separately as a new variety; if however the difference is only slight, it is proposed to substitute the improved selection as the replacement stock of the variety under the same name. This will, of course, ultimately mean the commercial propagation of the variety with slightly different average qualities from those it now possesses. From several of the Egyptian varieties now propagated such improved stocks have been isolated and are now being compared with the type.

Fresh individual plant selections can also be made from the targets and compared with the type. The present technique is to ratoon the whole of the plants in the Purity Chequer, storing them over the winter with identification labels. Out of the best-selected nucleolus strain of each variety twenty plants are chosen which fall well in the centre of the type-group in all targets. The ratoons of these are transplanted into the bee-proof cage, and represent the purest existing stock of the variety. In order to make a still further test for the existence of segregation, it is possible to examine these ratoon plants one by one. The present technique suggested is as follows. The characters of the actual ratoon plants growing in the cage will be re-targeted. Environmental fluctuation or inaccuracies which previously brought inside the type-group plants which should have lain outside it may now show up. Possibly five of the twenty plants will prove to be slightly different from the bulk. These will be eliminated, and fifteen will remain which, as regards their zygotic characters, truly represent the type of the variety. But they may not be equally genetically pure, and it is therefore necessary to re-target them one against the other. The same process (of selecting one of these substrains, and only the type-group from that) can then be repeated until a real pure-line is established. In case this may be thought by some to be over-elaborate, Fig. II will show the need for it. This is a seed-weight × ginning out-turn target of a nucleolus lot of Giza 3, originating by mixing the seed of the ratoon plants which had formed the type-group of a target made two years previously. The existence of segregation is clearly shown, but it is possible that if the ratoon plants had been re-targeted one by one, at least one or two would have been found to be homozygous for these characters.

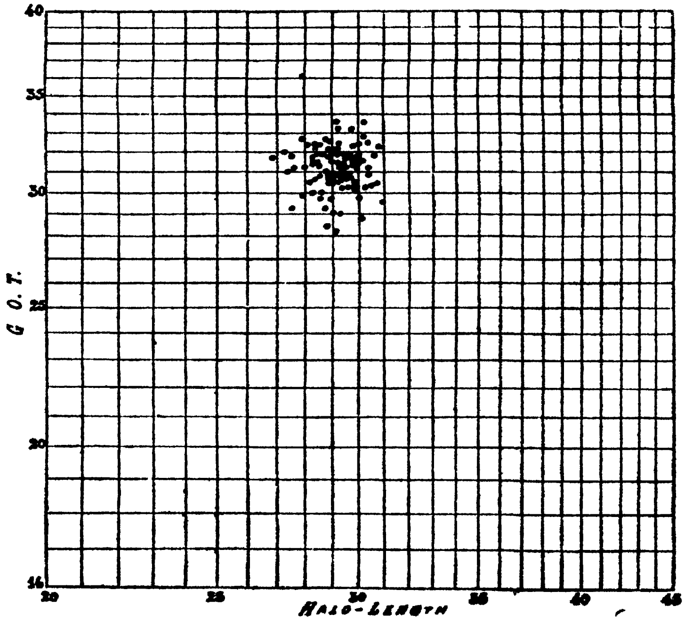
FIG. I.

HALO LENGTH x G.O.T

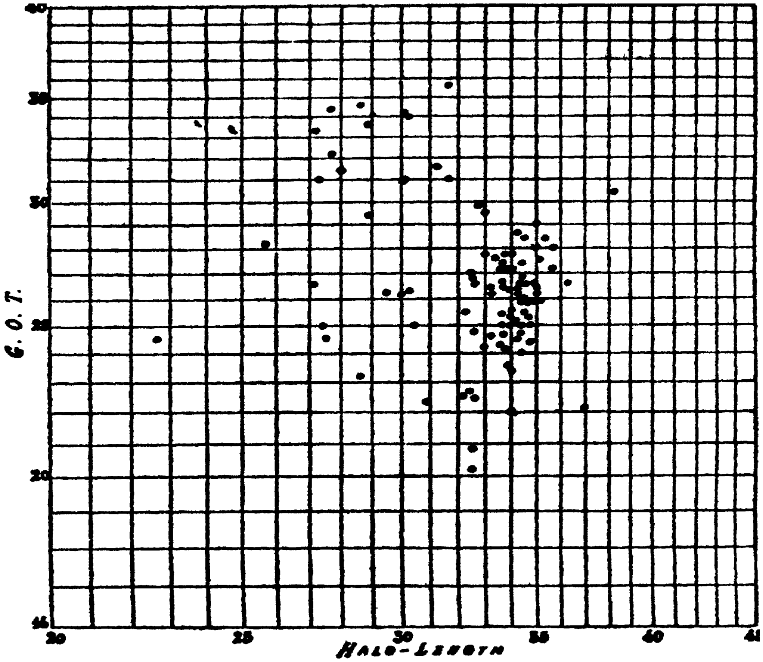
This represents the purest stock of New Sakel Domains



This represents the purest stock of Ashmouni Gedid



This represents an ordinary Commercial Sakel



This represents an ordinary Commercial Ashmouni

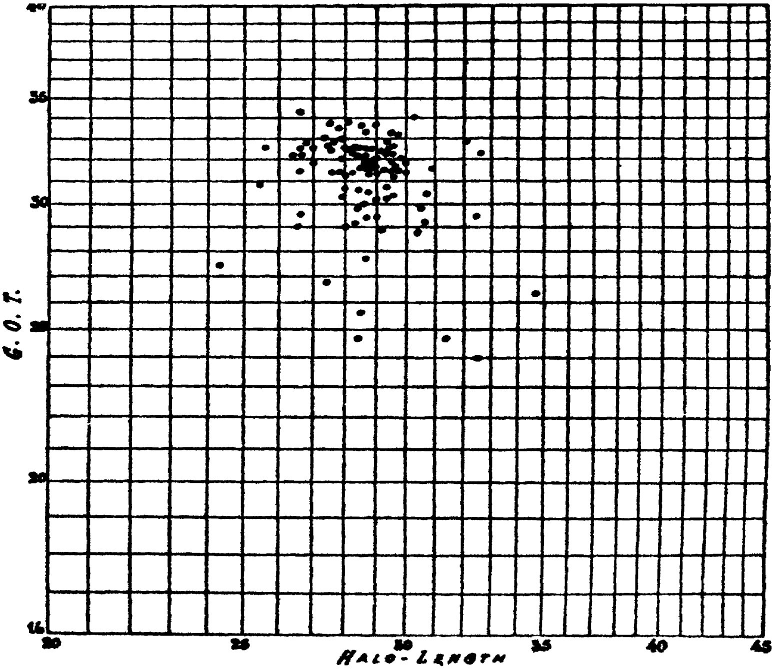
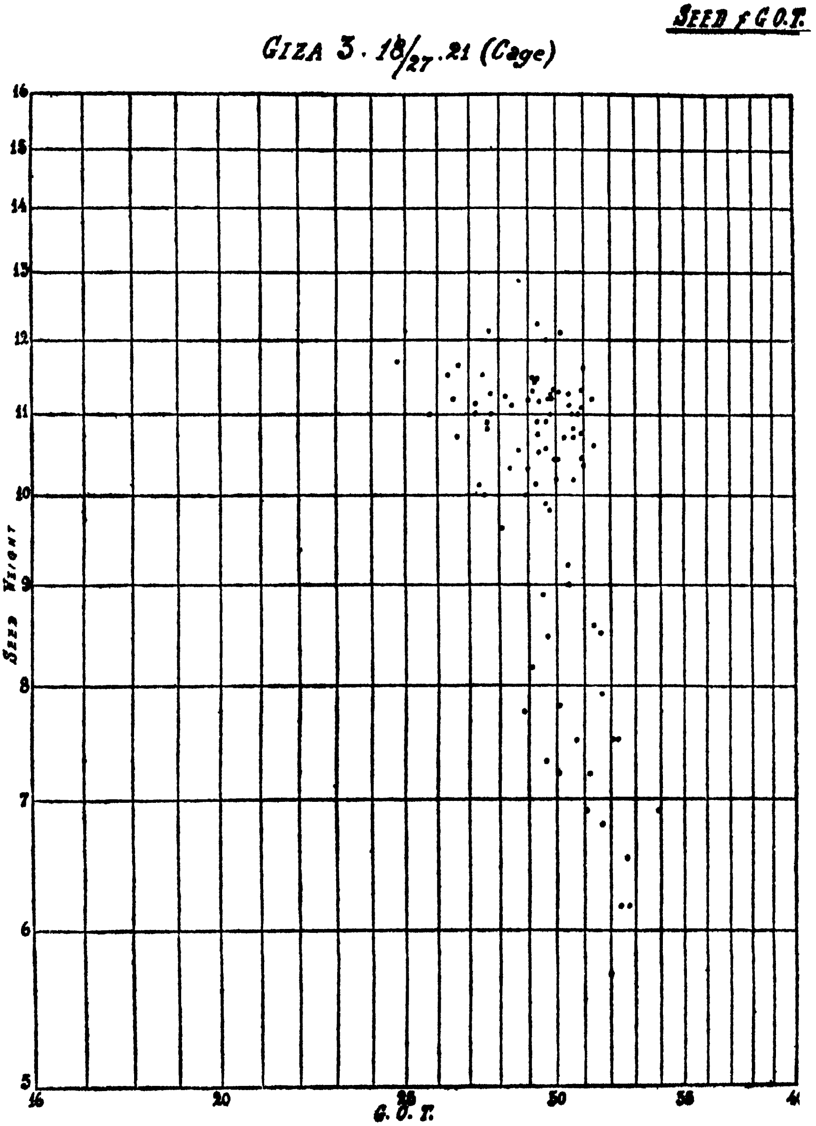


FIG. II.


SEED ∫ G.O.T.
GIZA 3. 18/27.21 (Cage)
16
15
14
13
12
11
10
9
8
7
6
5
SEED WEIGHT
16
20
25
30
35
40
G.O.T.

At the same time that the ratoons of the type-group of the selected strain are kept, ratoons are also kept of all desirable off-type plants of the variety, either off the target of the selected strain or any of these other strains. A large number of selections superior to the type in either halo-length, boll-weight, or ginning out-turn are now being made each year at Giza. The method is to grow all these unselfed for one year from the seed while the original ratoon plants are preserved in the cage. A large proportion are discarded on the examination of the family, while in those kept selfed seed is taken from the ratoon to make a family in the pedigree-line plot.

The Purity Chequer is thus serving at the same time as a means of complete purification of the type and of making new selections destined ultimately to replace the type or to be propagated separately. It is suggested that this method of selection can very profitably replace the old method of picking out plants from a bulk field.

Some examinations of hair-weight per centimetre on single plants from the Purity Chequer have recently been started and segregation found, so that here again selection will be made of plants finer than the type. If it were possible to measure the hair-weight of each plant in the chequer, this would be targeted against other plant-properties, or against hair-break, cell-diameter, etc. Our present resources do not admit of doing this extensively, but some limited studies in this direction show evidence that the utility of the Purity Chequer can be still further developed.

REFERENCES CITED.

[1] Balls, W. L. " Cotton Plant in Egypt," p. 131.
[2] Balls, W. L. " The Development and Properties of Raw Cotton," p. 131.
[3] Balls, W. L. *Ibid.*, p. 116.

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THE DIFFERENTIATION OF THE EPIDERMAL LAYER IN COTTON SEED AND ITS RELATION TO GINNING OUT-TURN

BY

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THE fundamental nature of this subject to all interested in cotton cultivation needs no emphasis. It affects both yield and quality, the former by determining ginning out-turn and the latter by affecting variability. It was first dealt with in considerable detail by Balls (1915) in his text-book " Raw Cotton." In Chapter III. he states that " The density of the lint on the boll is determined when the lint first originates by the protrusion of individual epidermal cells. There does not appear to be any further growth of epidermal cells into lint hairs after the first day (of flowering) in spite of accepted statements to the contrary." This statement is almost in accordance with both Biblical and modern genetic theory: " All the hairs on thy head are numbered," or, in other words, hairiness is hereditary.

In Chapter IV., however, in an attempt to account for the rise in ginning out-turn as the season advances, Balls definitely rules out genetics and states that " there is only one way in which this effect can be accounted for, namely, by changing the number of epidermal cells which sprout into hairs." He means, of course, an increase in the number. Then follows an explanation of how this differentiation is controlled by the nutrition of the ovule at the time of flowering.

In 1928 the present writer criticized this statement, and pointed out that the increase in ginning out-turn could be accounted for by the longer time of maturation of the boll resulting in increased secondary thickening of the lint hairs.

In 1929 Turner, working on the data published by Balls, was unable to find any support for the theory of predetermination of ginning out-turn at the time of flowering. On the contrary, he found that Balls' own results showed that a higher ginning per cent. was more generally associated with a smaller number of hairs per seed. This was also confirmed by data obtained from Indian cottons which showed that the ginning out-turn was most strongly correlated negatively with seed weight (−0·95).

Turner suggested that differentiation of lint hairs is not complete at the time of flowering, but continues for a considerable time afterwards. In support of this he quoted figures obtained in his laboratory by Gulati showing a fourfold increase in the number of hairs per seed from the first to the twenty-fifth day.

Harland (1929), in a review of the work of Balls, Barritt, and Turner, pointed out that anatomical evidence, namely, the basal constriction of the lint hairs, is not reconcilable with their continuous differentiation. He is definitely of the opinion that the number of hairs per seed is determined by hereditary factors and not by nutrition, either at the time of flowering or subsequently.

Gulati (1930) replied to this criticism and produced additional evidence of a sevenfold increase in number of hairs per seed between the first day after flowering and maturation of the boll. He also supported this by observations of mitosis in epidermal cells up to the tenth day after flowering.

Singh (1931) from cytological studies expressed his opinion in support of Gulati. He also made an interesting suggestion concerning the surface nutrition of the lint hairs from assimilates in the boll cavity secreted from the basal pits.

More recently Wanda K. Farr (1931), at the Boyce Thompson Institute, reports the occurrence of cell division in the epidermis of American cotton-seed up to the twelfth day after flowering. She also makes calculations showing that a thirty-twofold increase in surface area of the seed, with a simultaneous increase of only twofold in the length of the transverse axes of the cells, implies an increase in the number of cells. The basal constriction of the lint hairs is not recognized, and the suggestion of surface nutrition of the hairs put forward by the writer is opposed, owing to the absence of nutrients from the boll cavity.

DISCUSSION OF LITERATURE.

According to Turner, differences in ginning out-turn and variability of hair properties are probably due to environmental causes affecting the continuous differentiation of epidermal cells over a considerable period. Evidence of this is produced by Gulati and Farr, who found that the epidermal cells of the ovule continue to divide for a period of from twelve to twenty-eight days after fertilization.

If this evidence is correct, then increased differentiation of lint hairs should result in a rise of the ginning out-turn. Turner's investigations, however, support the opposite conclusion. Further, if this continuous differentiation is subject to variations in nutrition, this effect will not be confined to lint hairs, the number of fuzz hairs will also be subject to fluctuation. The amount of fuzz is not subject to environmental conditions, but is inherited in a simple Mendelian manner (Harland, 1930). Naked seeded cottons cannot be induced to develop fuzz under any system of cultivation.

Gulati's first evidence of continuous differentiation is based on cell counts in transverse sections of the seeds at different stages. This method is not quite so simple as it appears, and is bound to give low figures for hair cells in the early stages on account of their fragility. According to the writer's experience, good sections of the epidermis of the ovule during the first three days are almost impossible to prepare by any technique. (See micro-photographs by Wanda K. Farr, Figs. 2 and 3.) In his second paper Gulati gives surface counts of hairs on portions of the seed coat, but in these cases first-day counts only are compared with those of ripe seeds.

It is not to be supposed that even if all the hair cells are in existence on the first day after flowering they are necessarily recognizable in surface view. If cell division ceased promptly on the first day, it is not to be expected that all hair cells will elongate either simultaneously or at the same rate. For this reason the writer cannot accept Gulati's statistical evidence of continuous differentiation.

With regard to the calculations of Farr on the surface area of epidermal cells, these are based on measurements of the axes in transverse sections. Since the epidermal cells become very irregular in outline the tangential axis will vary according to the particular portion of the cell appearing in the section. This error in measurement will increase with the age of the cells, the older cells appearing to be much smaller than they are, so that a much larger number of cells is required to make up the increase in surface area.

In a previous paper the writer (1929) gave an average figure of a two-hundredfold increase in volume of the epidermal cells from the first to the twenty-eighth day. This figure was based on surface measurements of the seed coats multiplied by a sixfold increase in thickness of the epidermal cells. Dividing 200 by 6 we get 33 as the increase in surface area of the epidermal cells, which is in remarkable agreement with Farr's figure of 31·7 for the increase in surface area of the ovule. Thus the evidence from cell measurements does not support the possibility of continuous cell division in the epidermis.

There still remains the cytological evidence, which, of course, should be conclusive. Unfortunately, however, both Gulati and Farr have published only camera lucida drawings, which in both instances are too vague to be convincing. The drawings from ten-day old seeds show epidermal cells of the same size as the basal portion of the hair cells and of the same size as those of one-day old tissue. It follows from this that cell division is so rapid that cells of ten-day old ovules do not attain more than one day's growth. Cells in such a rapid state of division should be uniformly rectangular in shape, with a large central nucleus occupying most of the cell cavity. Such is not the case in the drawings made by Gulati and Farr. The writer, therefore, considers it desirable to publish actual micro-photographs.

Further Observations.

The results obtained by Gulati on Indian cottons were also confirmed by him on American cotton and by Farr on American and Sea Island cotton. There is therefore no reason to suppose that Egyptian cotton, which is a hybrid of New World cottons, should present any unique features in either structure or mode of development. The writer's observations were made on seeds of Egyptian cotton during 1927-28. Micro-photographs of transverse sections of seven-day old seeds and mature seeds are shown on the attached plates, and although they leave something to be desired, they do show the essential features. Seven-day material is chosen in preference to younger material, so that the various tissues are more easily recognized. Fig. 1 shows such a section in which the epidermis, mesophyll, and palisade cells are easily recognizable. It will be noted that the epidermal cells are of different sizes, some showing considerable elongation in a tangential direction. The nucleus is not conspicuous in any of these cells, and no cytologist would suspect the occurrence of mitosis in any of them. The palisade layer, on the other hand, has not yet begun to elongate, and consists of a uniform layer of rectangular cells with large nuclei occupying most of the cell cavity. It has all the appearance of meristematic tissue, and evidence of this is seen in Fig. 2, showing actual mitosis. In this case the cell division is tangential and gives rise to a further differentiation of mesophyll cells. The contrast between this layer and that of the epidermis only emphasizes the improbability of the occurrence of cell division in the epidermal layer.

The section of the mature seed (Fig. 3) shows the constriction of the base of the lint hair and the lateral extension of the epidermal cells. The difference in width of the epidermal cells is due chiefly to the particular portion of the cell occurring in the section. A surface view of the epidermal cells is shown in Fig. 4 in which the undulating outline of the cells gives the appearance of a jig-saw puzzle. Attempts to measure the number of lint hairs or the surface area of these cells from measurements of transverse sections are bound to lead to faulty conclusions.

Fig. 4 also shows the surface view of the constricted base of the lint hairs, which Farr considers to be a suitable path for the flow of nutrients to supply the requirements of secondary thickening. The absence of visible liquid from the boll cavity is not conclusive evidence against the theory of surface nutrition.

Independent evidence in support of the surface nutrition of the lint hairs can be found in Turner's analysis of the factors affecting the ginning out-turn. He found that the weight of lint per seed was the most variable factor of all and the weight of seed the least variable. If the lint hairs were able to withdraw their nutrients from the ovule through the base of the hair, it would be expected that lint weights would only fluctuate with seed weight. If, on the other hand, the lint hairs were dependent on nutrient escaping into the boll cavity, then lint weights would express a measure of the surplus nutrition of the ovule. A surplus is obviously much more liable to fluctuate than the basal requirements.

Since the number of hairs per seed is not determined by nutrition, the changes in lint weight per seed are correlated with changes in weight per hair, and therefore result in fluctuations in the quality of the cotton. This theory of surface nutrition of the lint hairs is thus of fundamental importance in the problem of uniformity in cotton cultivation. Fluctuations in the surplus nutrition of the ovule are largely determined by local climatic conditions, and account for those local differences in quality of the same strain, which are frequently greater than differences between varieties. These local differences are beyond the scope of any seed control law,* and provide the justification for the elaborate and much-maligned organization of the professional grader and merchant.

SUMMARY.

1. In a criticism of the work of Gulati and Farr it is shown that counts of lint hairs per seed and measurements of epidermal cells in transversal sections are not a reliable basis for determining the extent of continuous differentiation of the epidermal cells after fertilization.

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* See also *Nature*, 1931, No. 3241, p. 1001.

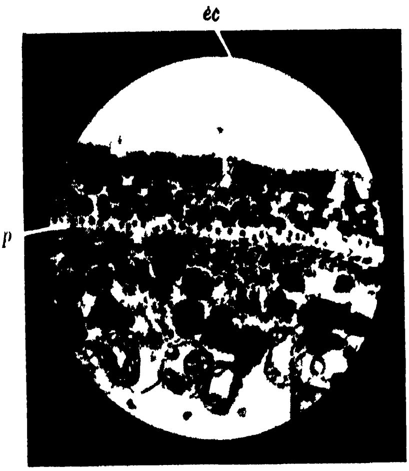

FIG. 1. T.S. OUTER INTEGUMENT (SEVEN DAYS) SHOWING PIGMENTED CELLS IN EPIDERMIS AND MESOPHYLL AND NUCLEATED PALISADE LAYER. × 300

ec epidermal cells

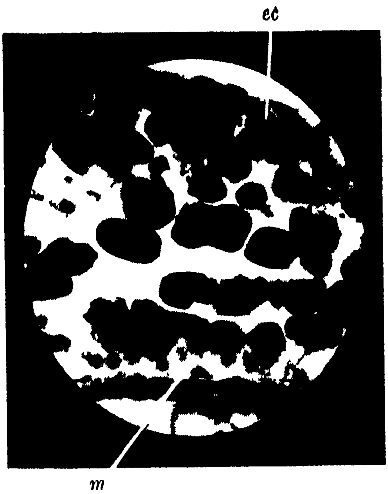

FIG. 2—T.S. SHOWING MITOSIS PALISADE LAYER × 900

m mitosis

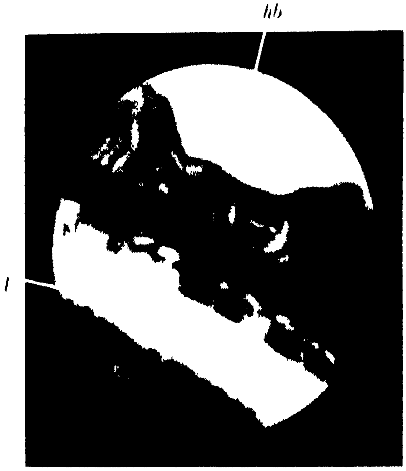

FIG. 3. T.S. OF SEED COAT AT MATURITY, SHOWING CONSTRICTED BASE OF LINT HAIRS 700

hb—hair base
p palisade layer

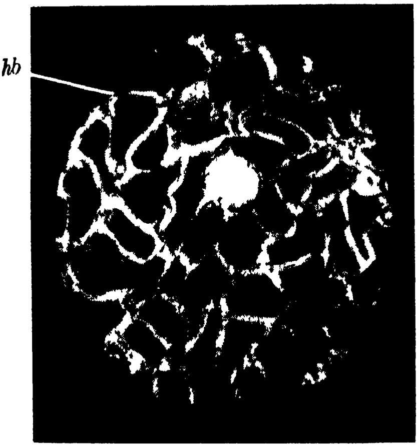

FIG. 4 SURFACE VIEW OF EPIDERMIS AT TWENTY FIVE DAYS SHOWING IRREGULAR CONTOUR OF CELLS AND STOMA × 700

2. Calculations of cell dimensions based on surface measurements fully account for the increased surface area of the seed by means of cell extension without division.

3. The occurrence of mitotic division in the epidermal cells at seven days is not confirmed, but its occurrence in the incipient palisade layer is recorded.

4. Fluctuations in lint weight per seed are accounted for, and support the theory of surface nutrition of the lint hairs. This is shown to have an important bearing on fluctuations in quality of different crops of the same variety.

ACKNOWLEDGMENT.

The writer's thanks are due to Dr. F. M. L. Sheffield and Mr. Hugh Nicol, M.Sc., of this station for much useful advice and assistance in taking the microphotographs.

REFERENCES.

BALLS, W. L. (1915): " Development and Properties of Raw Cotton." Macmillan and Co., London. P. 83.
BARRITT, N. W. (1928): Report of Brit. Assoc. for Advancement of Science.
,, (1929): *Annals of Botany*, xliii., 171, 483.
FARR, WANDA K. (1931): Contribution from Boyce Thompson Inst., vol. 3, No. 3, p. 441.
GULATI, A. N. (1930): *Agric. J. India*, xxv., 4, 313.
HARLAND, S. (1930): *Trop. Agric.*, vi., No. 12, p. 351.
SINGH, T. C. N. (1931): *Annals of Botany*, xlv., 178, 378.
TURNER, A. J. (1929): *J. Text. Inst.*, 20, 9, T.233-273.

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THE COTTON SUPPLY ASSOCIATION, 1857-1872

BY

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A BRIEF survey of the work of the Cotton Supply Association—a forerunner of the British Cotton Growing Association and the Empire Cotton Growing Corporation—may perhaps show how far we have profited by the lessons of the past, and may illustrate the extent to which the attitude of the public to a grave economic problem has changed within sixty years.

The peril of relying mainly upon America for our raw cotton was realized by far-seeing persons at an earlier date than is sometimes supposed. In an interesting letter, now in the British Museum (Add. MS. 38756 [255]), a Liverpool correspondent of the President of the Board of Trade wrote in June, 1828, of "the precarious situation of the cotton trade of this country from our too great dependence upon the United States for the supply of the raw material." It was not a war between North and South that was feared so much as a negro rising, a partial or total failure of the crop, interference with transport through storms, or the use in the Northern mills of an ever-increasing proportion of the Southern crop. Men like John Bright and Thomas Bazley who appreciated the danger urged both the Government and Lancashire business men to do all in their power to encourage the growth of good cheap cotton in the British Empire (particularly in India and the West Indies) and in Brazil, so that Lancashire mills would not suffer, even if supplies of American cotton declined.

It was for this purpose that the Cotton Supply Association was formed in Manchester in April, 1857. On June 19 a well-attended public meeting of the Association was held in the Manchester Town Hall which resolved that "the supply of cotton to this country is inadequate to the requirements of manufacturing industry, and, being almost entirely derived from one source, is uncertain in quantity and unduly fluctuating in price. That this meeting believes the colonial and other dependencies of Great Britain afford ample resources for the cultivation and development of the cotton plant, and that it is the duty as well as to the interest of the British nation to aid in the promotion of those efforts by means of which its growth may be extended not only in the British dominions, but in all accessible countries."

The methods which the Association proposed to use were summarized in a leading article in the *Cotton Supply Reporter* of November 1, 1858. The Association hoped to increase our sources of cotton supply " by bringing the necessary influence to bear upon our own and other Governments for the removal of restrictive duties or legislative obstructions to cotton growth or exportations in the British dominions or elsewhere; by obtaining and diffusing all available information as to countries capable of growing cotton, with a view to stimulating and directing private enterprise in its production; by circulating printed instructions as to the best methods of cotton farming and the preparation of cotton for the market; by grants of cotton seed, cotton gins, and machinery of the most approved kinds or construction, as inducements to private persons or associations to enter upon cotton culture; by sending out competent teachers or agents to countries where they would be likely to promote or improve cotton cultivation; by awarding honorary and other prizes to successful cultivators. . . ." This plan of action was followed. Prizes and medals were offered to cultivators. Over a thousand tons of seed were distributed in 1857-68, and gins and presses (with instructions as to how to use them) were sent to suitable applicants. Deputations assiduously discussed with Ministers various topics connected with the growth of cotton. In conjunction with the Manchester Cotton Company the Association sent Mr. Haywood to India to inquire into cotton prospects there. A cotton museum was started in Manchester. The Association arranged for a collection of cloth made from Indian cotton to be displayed at the International Exhibition of London in 1861, and sent samples and implements to the Turin Cotton Exhibition in 1864. Assistance was obtained from the Manchester Chamber of Commerce, which not merely passed on all relevant communications to the Association, but lent it such furniture as it could " conveniently spare." The P. & O. Company co-operated by sending cotton seed to India at half the usual rates.

The most effective work of the Association was done in 1861-64, when cotton supplies from the Southern States failed during the American Civil War. According to Thomas Ellison, Great Britain imported 1,261 million lb. of cotton from all sources in 1861. In the following year less than half this amount was obtained—533 million lb. Despite the inadequacy of the resources at its disposal and the difficulty of increasing suddenly the supplies of a raw material like cotton, the Cotton Supply Association did all in its power to encourage cotton cultivation. It was in no small degree due to its work that British imports of cotton rose slowly after 1862; nearly 690 million lb. were imported in 1863, 896 in 1864, 966 in 1865, and nearly 690 in 1866. The value of the cotton obtained during the cotton famine was lower than that obtained in normal times: the cost was considerably higher. On the whole, it was found possible to replace the long-stapled Sea Island variety by Indian and Syrian cotton, but no satisfactory substitute was discovered for the moderate stapled cotton (Middling Uplands) which could be used for almost any purpose, and which had hitherto formed the bulk of Lancashire's imports from the Southern States.

After the American Civil War adequate quantities of cotton were again received from the Southern States, and although the precariousness of this source of supply had only recently been shown, interest in the work of the Cotton Supply Association flagged. The Association lingered on for a few years and disappeared in 1872. It had had to face considerable difficulties. The prevailing economic doctrine of the day against which it had to contend was expressed by the gentleman who declined to join "the Cotton Supply Association, because he did not believe it proceeded upon a scientific basis. If they left the matter to the natural arbitrament of supply and demand, they would have no occasion to fear a dearth of cotton." Even at the height of the distress, in September, 1862, when a meeting adopted the Fifth Annual Report of the Association, "one of the largest manufacturers present declined, for want of time, to act upon the committee." And a year later the Secretary in a letter to the Liverpool press stated that the Association had spent £5,000 a year, and of this less than £70 a year came from Liverpool. It is clear that with a budget of only £5,000 a year the activities of the Association were strictly limited.

Nor was the Government particularly helpful. It is true that it allowed Dr. Forbes, manager of the Government cotton-growing factory at Dharwar, to accompany Mr. Haywood on his mission to India, and that H.M. Consuls were instructed to send to the Foreign Office information that might be of use to cotton manufacturers, but Lord John Russell distinctly stated that consuls should not "be allowed to incur any expenditure of public money on this account." Any direct financial assistance from the Government was out of the question. Those who are endeavouring to increase British sources of cotton supply today are in a more fortunate position in this respect.

To the lack of interest on the part of many Lancashire manufacturers and of the Government must be added the mistakes of the Cotton Supply Association itself. First, the Association extended its activities over too wide a field. Any insignificant island in the tropics in which cotton had been known to grow was liable to have a stack of leaflets presented to it. Any traveller who thought he had seen cotton growing wild a thousand miles from a proper road was listened to with rapt attention. The Empire Cotton Growing Corporation and the British Cotton Growing Association have wisely concentrated their activities upon a somewhat narrower area.

Secondly, the Cotton Supply Association approached the problem of increasing cotton supplies in a somewhat amateurish spirit. It seemed to assume that anyone could grow cotton by following the instructions printed in leaflets. To ask enthusiastic missionaries and less enthusiastic Colonial Governors and consuls to distribute seed, gins, and leaflets and then to hope for the best was a somewhat rough-and-ready procedure which could be excused only on the plea that the funds at the disposal of the Association did not permit it to do anything further. The careful scientific work on cotton culture now being done in those parts of the Empire where there is a reasonable chance of success is in striking contrast to those earlier haphazard methods.

From one point of view those who were working in the sixties to increase our cotton supplies were in a happier position than their successors today. Then, the supply question was the only real danger threatening the cotton industry: competition from Continental and New England factories was not severe, and the mills of India and Japan were only in their infancy. Today the problem of supply is only one of many that the industry must solve if it is to recover something of its former prosperity.*

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* The work of the Cotton Supply Association is best studied in its own publications—the Annual Reports, *The Cotton Supply Reporter* (published fortnightly until April 1, 1863, and then monthly), pamphlets and special reports such as F. Fowler's "Report on the Cultivation of Cotton in Egypt," 1860, and I. Watts's "Report on India as a Source of Cotton Supply," 1870. The files of *The Times* and of local papers such as the *Manchester Guardian* and the *Manchester Daily Examiner and Times* should also be consulted. I. Watts, who was Secretary of the Association from 1863 onwards, wrote a short account of its work—"The Cotton Supply Association: Its Origin and Progress" (Manchester, 1871).

COTTON STATISTICS

WORLD'S CROPS—AMERICAN AND EGYPTIAN

BY

JOHN A. TODD, M.A., B.L.

The feature of the world's cotton supplies during the season which is now drawing to a close has been the extraordinary change in the relative position of American and all other crops, for the American crop is the second largest in history, while the total of Outside Growths is the smallest since 1926 (the year of the record American crop), thus providing another illustration of the curious compensatory effect which has been noted so often in recent years, a big American crop being to some extent set off by a comparative failure of other crops. The result is very strikingly shown by the divergence of the two middle lines in the diagram on p. 142.

The extent of the extraordinary "come-back" of the American crop is best realized from the figure of the average yield per acre. As will be seen from the figures in Table II., the acreage showed a fair reduction, just over 10 per cent., which by the way was a great deal less than was justified by the economic conditions of cotton prices, but as the result of a most favourable, but apparently entirely fortuitous combination of weather conditions the average yield, according to the Government's December estimate, was 200·1 lbs. per acre, which far exceeds even the previous record crop of 1926 (182·6 lbs.); it is actually the highest yield recorded since 1914 (209·2 lbs.), and that was before the boll weevil had covered anything like the whole Belt. It is not possible to point to any one particularly favourable feature of the season which would explain the result. The fact seems to be that all the different kinds of weather that the crop requires came along just exactly at the right time and to the right extent, so that everything favoured the crop and yet there was no great weevil damage, so that this year there was neither Scylla nor Charybdis to wreck the crop. Finally, the favourable weather conditions seem to have affected the quality of the crop as beneficially as the quantity, and reports indicate that the average staple of the crop will be from a sixteenth to an eighth of an inch more than in any recent year, while the percentage of untenderable cotton is the smallest since the Government first began to record these figures.

On the other hand, as will be seen from Table I., nearly all the other principal crops of the world have suffered a pretty severe setback this year. Brazil, the Argentine, India, China, and Egypt all show figures substantially below those of last year, and the only material increase is in Russia, where, however, the figures are still subject to considerable revision.

The result is that in spite of an increase of three million bales in the American crop, the world's total is only about two million bales more than last year, which still makes it the third largest total on record, and about a million bales above the pre-war record of 1914. The total of Outside Growths is about a million bales below the figures of the two previous years, but the percentage of Outside Growths on the total is the smallest in the table, except for 1920 and 1926.

Table III. gives the details of the Egyptian crop, the chief feature of which was the heavy reduction in acreage, 19·2 per cent. (mostly in Upper Egypt), and the still further reduction of the yield as the result of another comparative crop failure. The chief interest, however, in the Egyptian statistics will be found in Table IV., which gives the area by varieties. This year the Government have introduced a new system of classifying the varieties as Long Staple, Medium, and Short; and we have therefore recast our table, following the same lines and showing the percentage of each group on the total since 1919 with 1914 for comparison. It will be seen that in 1931 the long staple group shows the smallest percentage since the war, as the result of the legislative restriction of Sakel to a special zone in the Delta. The resulting reduction of Sakel, however, was to some extent set off by the increase in the other long staple varieties. The fact that the Government included Pilion among the short staple varieties was rather a surprise, and largely accounts for the result that the percentage of short staple varieties in 1930-31 is the highest on record.

It is very satisfactory to know that the first reports of the Sudan crop this winter show a good recovery from the serious failure of the previous year. It is too soon yet to say whether this is the result of the measures adopted this season to combat the black arm and leaf crinkle pests, or whether it has been mainly due to more favourable weather conditions.

TABLE I.—WORLD'S COTTON CROPS, 1914-1931.

(Bales of 500 Lbs. Approximately, 000's Omitted.)

	1914–15.	1915–16.	1916–17.	1917–18.	1918–19.	1919–20.	1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.
America.																		
U.S.A. Lint	16,135	11,192	11,450	11,302	12,040	11,421	13,440	7,954	9,762	10,140	13,628	16,104	17,977	12,956	14,478	14,825	13,932	16,918
Linters	857	931	1,331	1,126	930	608	440	397	608	668	897	1,115	1,158	1,016	1,282	1,241	986	900
Total	16,992	12,123	12,781	12,428	12,970	12,029	13,880	8,351	10,370	10,808	14,525	17,219	19,135	13,972	15,760	16,066	14,918	17,818
Mexico	125	109	111	95	245	200	194	145	191	160	221	199	351	175	272	240	178	209
Brazil	456	312	310	374	374	463	430	491	538	561	649	589	490	480	511	563	486	*400*
Peru	118	105	119	120	132	159	166	181	188	201	198	186	243	241	215	235	205	*200*
Argentine	3	4	3	12	15	15	28	18	29	62	75	136	65	103	129	144	134	105
Others	8	11	12	12	11	9	11	45	26	67	84	70	74	62	76	70	60	*50*
Asia.																		
India*	5,209	3,738	4,489	4,000	3,972	5,796	3,600	4,485	5,073	5,161	6,088	6,215	5,024	5,963	5,782	5,125	4,820	*4,250*
China	2,333	1,882	1,534	2,046	2,903	2,470	1,829	1,488	2,249	1,931	2,104	2,044	1,707	1,833	2,114	1,995	2,350	1,825
Japan and Korea	37	45	37	60	71	92	103	89	106	113	122	122	141	131	147	137	154	136
East Indies, etc.	23	23	37	16	25	20	31	27	26	21	20	19	13	16	15	16	20	*20*
Russia	1,244	1,474	1,137	615	296	200	66	42	52	214	458	741	785	1,025	1,174	1,324	1,550	*2,000*
Persia	140	135	96	84	86	122	102	95	63	79	58	82	83	73	90	82	124	*120*
Iraq, Ceylon, etc.	†	†	†	†	†	†	†	†	†	1	2	3	3	2	4	4	3	3
Asia Minor and Europe	140	113	117	104	95	114	106	45	39	78	110	151	134	145	131	151	148	*154*
Africa.																		
Egypt	1,298	961	1,022	1,262	964	1,114	1,206	972	1,243	1,306	1,455	1,593	1,727	1,219	1,602	1,697	1,589	1,270
Sudan	19	13	18	9	13	19	24	19	23	38	36	97	118	101	129	127	97	160
East Africa (British)	34	27	26	27	35	43	75	49	80	119	180	168	128	128	196	135	175	190
South Africa (British)	1	1	1	1	2	2	2	2	5	9	18	22	9	9	8	14	9	*10*
West Africa (British)	12	6	16	10	14	13	24	12	13	21	32	39	22	17	26	35	20	*20*
Non-British	4	3	7	8	8	11	13	16	26	39	65	74	87	86	104	100	100	*100*
West Indies (British)	5	4	3	3	4	5	5	4	3	4	3	3	5	5	3	4	6	*5*
West Indies (Others)	11	7	7	9	8	17	11	22	17	17	19	25	24	21	23	25	21	*25*
Australia, etc.	†	†	†	†	†	†	1	3	7	10	12	6	5	8	5	10	9	*9*
World's Total	28,212	21,096	21,883	21,295	22,243	22,913	21,907	16,601	20,367	21,020	26,534	29,803	30,373	25,815	28,516	28,299	27,176	29,079
Outside Growths	11,220	8,973	9,102	8,867	9,273	10,894	8,027	8,250	9,997	10,212	12,009	12,584	11,238	11,843	12,756	12,233	12,258	11,261
Per cent. on Total	39·8	42·5	41·6	41·6	41·7	47·5	36·6	49·7	49·1	48·6	45·3	42·2	37·0	45·9	44·7	43·2	45·1	38·7

* Government Estimate, 400 lb. bales.

† Less than 500 bales.

Estimates in *italics*.

TABLE II.—AMERICAN ACREAGE, CROP, YIELD PER ACRE, AND PRICE, 1911–31.

Season.	*Acreage Harvested* (000's).	*Crop (Running Bales, 000's).*			*Average Yield (Lbs. per Acre) (Ex Linters).*	*Average Price Middling (Pence per Lb.).*
		Cotton.	*Linters.*	*Total.*		
1911–12	36,045	15,553	556	16,109	207·7	6·09
1912–13	34,283	13,489	602	14,091	190·9	6·76
1913–14	37,089	13,983	631	14,614	182·0	7·26
1914–15	36,832	15,906	832	16,738	209·2	5·22
1915–16	31,412	11,068	945	12,013	170·3	7·51
1916–17	34,985	11,364	1,300	12,664	156·6	12·33
1917–18	33,841	11,248	1,096	12,344	159·7	21·68
1918–19	36,008	11,906	910	12,816	159·6	19·73
1919–20	33,566	11,326	595	11,921	161·5	25·31
1920–21	35,878	13,271	429	13,700	178·4	11·89
1921–22	30,509	7,978	382	8,360	124·5	11·37
1922–23	33,036	9,729	591	10,320	141·5	14·92
1923–24	37,123	10,171	640	10,811	130·6	17·66
1924–25	41,360	13,639	858	14,497	157·4	13·76
1925–26	46,053	16,123	1,044	17,167	167·2	10·77
1926–27	47,087	17,755	1,042	18,797	182·6	8·15
1927–28	40,138	12,783	875	13,658	154·5	11 17
1928–29	45,341	14,297	1,086	15,383	152·9	10·52
1929–30	45,793	14,548	1,038	15,586	155 0	9 09
1930–31	45,091	13,756	824	14,580	147·7	5·71
1931–32	40,495	*16,400*	*750*	*17,150*	200·1	—

Estimates in *italics.*

TABLE III.—EGYPTIAN AREA, CROP, YIELD, AND PRICE, 1914–31.

Season.	*Area. Feddans.* 000's.	*Crop. Kantars.* 000's (*A.G.P.A.*).	*Average Yield per Feddan* (*Kantars*).	*Season's Average Prices.*		*Sudan Crop. Kantars.* 000's.
				F. G. F. Brown. Pence per Lb.	*Premium over American Middling* (*per Cent.*).	
1914–15	1,755	6,490	3·70	7·34	40	95
1915–16	1,186	4,806	4·06	10 42	39	65
1916–17	1,656	5,111	3·10	21 56	75	92
				Sakel.		
1917–18	1,677	6,308	3·75	30·97	43	45
1918–19	1,316	4,821	3·66	27·85	41	64
1919–20	1,574	5,572	3·54	60·34	139	93
1920–21	1,828	6,030	3·30	30·24	154	122
1921–22	1,292	4,858	3·76	19·75	74	96
1922–23	1,801	6,213	3·45	17·29	16	113
1923–24	1,715	6,531	3·81	21·55	22	191
1924–25	1,788	7,274	4·07	29·82	117	180
1925–26	1,924	7,965	4·14	20·05	86	485
1926–27	1,786	8,635*	4·84	15·39	89	592
1927–28	1,516	6,097	4·02	19·39	74	534
1928–29	1,738	8,012	4·61	18·14	72	684
1929–30	1,841	8,485	4·61	14·52	60	672
1930–31	2,082	7,947	3·82	9·06	34	514
1931–32	1,683	*6,350*	*3·77*	—	—	800

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* The Government's final estimate was 7,652,190 kantars, the difference being the carry over up-country.

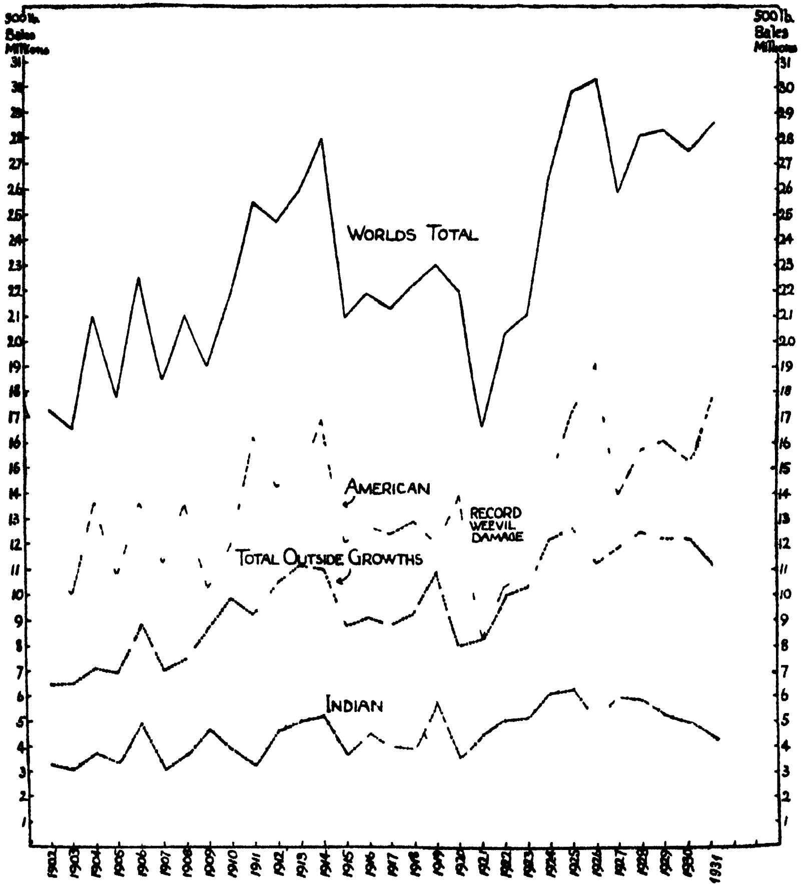
TABLE IV.—EGYPTIAN CROP: AREA BY VARIETIES.

(FEDDANS 000's.)

STAPLE AND VARIETY.	1914.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	1929.	1930.	1931.
***Long Staple*:**														
Sakel	394	1,146	1,270	995	1,358	1,255	873	1,129	982	796	800	848	837	479
Jannovitch	128	*	2	*	*	—	—	—	—	Maarad	—	22	66	111
Abbassi	12	4	13	1	2	—	—	—	—	Giza 7	—	—	5	35
										Sakha 4	—	—	—	4
Group Total ..	534	1,150	1,285	996	1,360	1,255	873	1,129	982	796	800	870	908	629
Per Cent. of Total	*30·4*	*73·1*	*70·3*	*77·1*	*75·5*	*73·2*	*48·8*	*58·7*	*55·0*	*52·5*	*46·0*	*47·3*	*43·6*	*37·3*
***Medium*:**														
Nubari	262	24	37	9	11	11	—	—	—	Nahda	26	44	25	53
Afifi	467	35	44	7	8	6 }	22	8	4	4	Fouadi	14	33	40
Assili	134	21	30	6	8	8 }					Casouli	11	9	6
Group Total ..	863	80	111	22	27	25	22	8	4	4	26	69	68	99
Per Cent. of Total	*49·2*	*5·1*	*6·1*	*1·7*	*1·5*	*1·5*	*1·2*	*0·4*	*0·2*	*0·3*	*1·5*	*3·7*	*3·3*	*5·9*
***Short*:**														
Ashmuni	354	334	284	171	276	310 }	796	{ 271 }	667	599	768	{ 419 }	936	759
Zagora	—	—	98	93	127	102 }		{ 389 }				{ 385 }		
Pilion	—	—	—		*	*	50	73	102	74	97	88	124	157
Giza 3	—	—	—	—	—	—	—	—	—	—	—	—	36	38
Others	4	9	50	10	10	23	47	55	30	43	47	11	9	2
Group Total ..	358	343	432	274	413	435	893	788	799	716	913	903	1,106	956
Per Cent. of Total	*20·4*	*21·8*	*23·6*	*21·2*	*23·0*	*25 3*	*50 0*	*40·9*	*44·8*	*47·2*	*52·5*	*49·0*	*53·1*	*56·8*
Grand Total ..	1,755	1.574	1,828	1.292	1 801	1,715	1.788	1,924	1,786	1,516	1 738	1,841	2,082	1,683
Lower Egypt	1,373	1,219	1,379	1,012	1,378	1,289	1,264	1,363	1,248	1.039	1,143	1,218	1,387	1,193
Per Cent of Total.	*78 2*	*77·5*	*75·4*	*78 4*	*76·5*	*75·2*	*70·7*	*70·8*	*69·9*	*68·5*	*65·8*	*66·2*	*66·6*	*70·9*
Upper Egypt	382	354	449	280	423	425	523	561	537	477	595	623	695	490

Less than 500 feddans.

WORLD'S COTTON CROPS.
AMERICAN v OUTSIDE GROWTHS.



NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

81. The following reports have recently been received:
Review of Agricultural Operations in India, 1928-29.
Annual Report of Imperial Council of Agricultural Research, 1929-30 and 1930-31.
Madras: Rpt. of Operations of Dpt. of Agr., 1930-31.
Mysore: Rpt. of Agr. Dpt., 1930, Pts. I. and II.
Punjab: Rpt. of Operations of Dpt. of Agr., 1931, Pt. I.

82. Report of the Imperial Council of Agricultural Research, 1929-31. This is the first report, and deals with the working of the Council since its inception in 1929. Cotton does not come under its direction.

83. Indian Central Cotton Committee. At the twenty-fourth meeting, held in December last, many important subjects came before the Committee. Action was taken towards protecting growers from penalization by combines of factory owners. Owing to the increasing importance of Sind as a cotton-growing province, the Government was asked to give it separate representation. Investigations on rotations were put in hand. A long discussion took place on past work and future policy. A number of research schemes were sanctioned.

84. Sind and the Lloyd Barrage. (Printed at Govt. Central Press, Bombay, 1931.) An excellent publication, giving a description of the barrage, with an account of land policy and agricultural development contemplated, administration, finance, etc. It is anticipated that under the new conditions the total cotton area will rise from 300,000 to 800,000 acres. The Indian Central Cotton Committee has sanctioned a grant of Rs. 31,000 per annum for three years for the extension of improved varieties of cotton in the Barrage area, and expresses the opinion that "cotton with a full 1-inch staple always has a better market than any other kind, and it will, therefore, be desirable to go in for more of this type of cotton." It is suggested that the present cottons under cultivation in Sind should be improved by the establishment of experimental farms, selection of the best strains by experts, provision of seed-growing farms and distributing centres for the supply of pure seed, prevention of mixing by the licensing of ginning factories, and prevention of adulteration.

85. Bombay Cotton Annual, 1930-31, No. 12. The usual authoritative compendium of all matters relating to the cotton trade. Contains statistics of crops, exports, imports, prices, stocks, consumption, Government notifications, etc., necessary for all who are interested in the production, distribution, and consumption of Indian and foreign cottons, yarn, and cloth.

86. Indian Cotton Review, 1930-31. (Pubd. by Chunilal Mehta and Co., Bombay.) This report is somewhat depressing reading; it maintains, however, that the position of Indian cotton is essentially more sound than that of American. Various tables are included dealing with the supply, distribution, and stocks of Indian cotton; Bombay cotton prices; weekly cotton movements and cotton receipts; Indian cotton acreage and production; exports; cotton yarn and piece-goods prices; consumption of Indian cotton in Indian mills, etc.

87. MADRAS. *Cotton Cultivation.* (*Operations of Dpt. of Agr.*, 1930-31.) The working of the Cotton Ginning Act and the Cotton Transport Act is described. The chief work in connection with cotton consisted in the distribution of strains of Cambodia, Karunganni, Westerns and Northerns cottons in the different centres.

88. MYSORE. *Cotton Cultivation.* (*Rpt. of Agr. Dpt.*, 1930.) The distribution of Sannahatti (Selection 69) is steadily spreading into new areas. A report from the Technological Laboratory of the Indian Central Cotton Committee states that this cotton is "creamy-white to creamy in colour; perfectly clean, bright, well-ginned, has a good feel; the staple is regular and strong." It is suitable for 20's warp. The area under cultivation is approximately 20,000 acres.

Work is under way on the hybridization of Indian cottons and also of American cottons to combine good staple with high ginning percentage.

89. PUNJAB. *Cotton Investigations.* (*Rpt. of Operations of Dpt. of Agr.*, 1931, Pt. I.) Investigations have shown that a strain, T.35, gives promise of high resistance to jassid, and is early maturing; the staple is also of good length. The hairy types, N.T.1 and S. Labh Singh's selection, also promise well though they are late yielders, and the latter has rather a short staple.

90. NOTE ON A SOWING DATE EXPERIMENT WITH PUNJAB-AMERICAN COTTONS AT LYALLPUR IN 1930. By T. Trought and M. Afzal. (*Agr. and Livestock in India*, i., **6**, 1931, p. 631.) The results of the 1930 sowing date experiments differ from those of previous years. This is attributed to the particularly mild season, and it is shown that these results support the arguments previously advanced in favour of later sowings in normal or severe seasons.

[*Cf.* Abstr. **186**, Vol. VIII.]

91. AGRICULTURAL CHARACTERISTICS OF INDIAN AND AMERICAN COTTONS IN THE KUMPTA-DHARWAR AREA. By G. L. Kottur. (*Agr. and Livestock in India*, i., **5**, 1931, p. 522.) A study has been made of the following: habit of growth; flowering; sowing time; soil exhaustion, manuring, and rotation; resistance to drought; irrigation; insect pests; fungoid diseases.

The results of the study indicate that in many respects American cottons are agriculturally superior to Indian cottons, but their chief attraction is the possession of a longer staple. Notwithstanding all the efforts that have been made, however, it has not been found possible to grow longer-stapled varieties capable of spinning finer counts. Some Indian cottons can be spun up to 40's counts, and since the American cottons cultivated so far are not much better than these growths, the former have still some attraction both for growers and for consumers. Writing of the future for American cotton in the Kumpta-Dharwar area, the author states that the main problem confronting the grower is the elimination or checking of leaf blights (which are the chief cause of the failure of American cottons in the district), since only American cottons which resist the blights, and in addition possess good long staple with finer spinning properties, have any chance of success.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

92. The following reports have recently been received:

The Journal, 1932, South-Eastern Agr. Coll., Wye.
Rpt. of Sci. and Indus. Res., 1930-31.
CYPRUS: Ann. Rpt. of Dpt. of Agr., 1930.
GOLD COAST: Rpt. of Dpt. of Agr., 1930-31.
IRAQ: Ann. Rpt. on Cotton, 1929.

NIGERIA: Ann. Bull. of Agr. Dpt., 1930.
Ann. Rpt. of Agr. Dpt., 1930.
NORTHERN RHODESIA: First Ann. Bull. of Dpt. of Agr., 1931.
QUEENSLAND: Ann. Rpt. of Dpt. of Agr. and Stock, 1930-31.
SUDAN: Finan. Admin. and Condition of the Sudan in 1930.
TANGANYIKA: Third Ann. Rpt., Amani, 1930-31.

93. REPORTS RECEIVED FROM EXPERIMENT STATIONS, 1930-31. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d., post free.) In this volume an alteration has been introduced into the method of presentation of the reports. It is felt that, while it is the duty of those engaged in the actual prosecution of such work as is described to read the reports in detail, others may find them too bulky. With the object of also interesting the latter in the work that is going on the Executive Committee have decided that each individual station shall only bring out a full report once in three years; there will thus be four full reports as a rule in each volume, while the other stations will produce each a brief summary. The full reports contained in the present volume are from Iraq, Anglo-Egyptian Sudan, Uganda, and Southern Rhodesia.

An account is given of the extensive breeding work that is going on. U.4 continues to be the most prominent item, but experiments with other strains have also given promising results. Much useful work is described dealing with cultivation and harvesting methods; rotation of crops; time of sowing, spacing, and intercropping experiments; control of pests and diseases, etc. The reports should prove of much interest to those concerned with the breeding and cultivation of cotton and other similar crops.

94. CEYLON. *Cotton Cultivation*, 1930. (*Admin. Rpt. of Dir. of Agr.*, 1930, recently received.) As in previous years all cotton grown under the peasant schemes in the Hambantota District and around Embilipitiya was purchased by the Department of Agriculture on behalf of the Ceylon Spinning and Weaving Company at the price of Rs. 16 per cwt. of seed cotton. It is feared that the fall in prices may adversely affect what has been accomplished in the encouragement to grow cotton.

The seed was as usual supplied by the Department, and a fresh stock of strain No. 15 of Cambodia cotton was imported from the Madras Presidency. No pests or diseases of a serious nature occurred; there were the usual attacks of leaf roller and a few cases of cotton wilt. Very great damage, however, was caused by elephants, several chenas being completely destroyed by a herd in a single night.

95. CYPRUS. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1930.) The cotton crop of the year reached 56,166 cwt., which is the highest figure recorded since 1890. Heavy and continuous rains fell during the winter of 1929-30, and in consequence greater areas were made available for planting unirrigated cotton. Bollworm damage was severe, and special attention is being given by the Department to pest control. In varietal trials encouraging results were obtained under non-irrigated conditions with "Mesowhite" cotton, both as regards yield and quality of the lint, and a considerable quantity of this seed has been sold to farmers by the Department.

96. IRAQ. *Annual Report on Cotton*, 1929. By E. Guest. (Mem. No. 15, *Dpt. of Agr., Iraq*, 1931.) This report, which has recently been received, deals chiefly with the cotton work at Rustam Experiment Farm near Baghdad for the season 1929. An account is given of the climate and its effect on the cotton crop. The commercial variety of cotton grown is Mesowhite, a selection from the long-

stapled American cotton Webber 49-3. The economics of cotton-growing are discussed, and figures given showing the actual profit realized for cotton grown by paid labour on a Rustam propagation area. An estimate of the cost of growing cotton on the share system is also attempted, and the economics of the two systems are compared. The ordinary routine method of cultivation at Rustam is described. The chief varieties propagated are R.82, a Mesowhite strain, and R.124, a cross-bred strain with a high ginning percentage. An account is given of varietal trials, breeding, and selection work carried out at the Station.

97. AFRICA. *Report of Committee on Closer Union in East Africa.* (Pubd. H.M. Stat. Off., 1931. Price 1s. 6d. net.) In connection with the scientific services, it is pointed out that the effective co-ordination of scientific and technical research is of great economic importance to the future of East Africa. Joint advisory committees are suggested for the various problems. "Long-range" research is already provided for to a great extent at Amani, but problems in connection with human, animal, and plant diseases still require investigation. It is suggested that a common fund be established for the work, and contributed to by the various Governments concerned.

98. NIGERIA. *The Ninth Ann. Bull. of the Agr. Dpt.*, 1930, contains particulars of various experiments with cotton carried out at Ilorin Plantation, Samuru, Kano, Badeggi, Yandev, and Maigana Seed Farm. The experiments included varietal, rotation, manurial, ridging, time of planting, and growing cotton through yams.

99. *Cotton Cultivation.* (*Half-yearly Rpt. of Dpt. of Agr. to September* 30, 1931.) *Northern Provinces.*—Owing to the locust invasion and its effect on food supply, and also to the low prices paid last year, less acreage than usual was planted to cotton in the 1931-32 season.

Southern Provinces.—4,289 bales of Ishan cotton were purchased in the 1930-31 season, as compared with 6,000 bales the previous year. The disadvantage of this cotton hitherto has been its roughness, and selection work has been carried out by the Cotton Breeder at Ibadan with a view to evolving a cotton of equal hardiness but with softer lint. The results of measurements made by the Shirley Institute on a reselection of Ishan A, and on some crosses made between Ishan A and Ishan B, have been extremely encouraging. The brokers' opinions were also satisfactory, and it is hoped within a year or two to produce a cotton distinctly superior to the present Ishan A.

100. NORTHERN RHODESIA. We have received a copy of the *First Annual Bulletin of the Department of Agriculture,* 1931. The issue of this publication inaugurates a new system of recording the experimental work of officers of the Department, and of placing it before the general public. The Bulletin is intended as a more convenient and efficient record of the work than the *Occasional Papers* and appendices to the Annual Reports, which have hitherto been used for this purpose.

Cotton Cultivation.—With the assistance of the Corporation, the Dept. of Agriculture has, during the last three years, undertaken a systematic investigation into the cotton prospects of the Territory. An interesting review of the past history of the crop is given by Mr. A. C. Bebbington, the Corporation's Cotton Selection Officer. Attempts to establish cotton, which is a valuable rotation crop with maize, have not yet proved successful owing to low prices and insect pests. U.4 has to a large extent solved the jassid problem, but stainers and bollworms are still limiting factors. A good description is given of the work against these pests.

101. SOUTH AFRICA. *Cotton Cultivation*, 1930-31. (*Farming in S. Afr.*, vi., 68, 1931, p. 297.) Owing to late planting, due to drought, a reduced crop was harvested. Experimental work was continued at Rustenburg and Barberton. At the latter station the work of the Empire Cotton Growing Corporation was a great factor in the success of Low-veld cotton production. The investigations on bollworms and other pests are being continued.

102. *Review of the* 1930-31 *Cotton Crop*. (*Crops and Markets*, x., 8, 1931.) The acreage planted to cotton was approximately 30 per cent. less, due to the fall in prices. Late rains delayed planting throughout the dry lands, and lengthy periods of drought during the growing season caused excessive shedding. In the irrigated areas of the Orange River, the lint of the first pickings was weaker than usual owing to lack of water for irrigation, but later improved, coming well up to standard. Bollworm did considerable damage, but other pests were not in evidence.

103. *Kakamas Experimental Plot*. By E. A. Gutsche. (*Ann. Rpt.*, 1930-31.) The season 1930-31 generally was considered poor, with small yields and low prices. The smaller yields were due to scarcity of irrigation water during December and January, causing considerable shedding in early planted cotton. Late planted crops did not suffer to the same extent, and according to information from the Government Cotton Grader, the later pickings were again up to standard. About 10,000 bales were produced in the area. It is doubtful whether the 1931-32 acreage put to cotton will be materially lower, since even at the low prices ruling cotton compares favourably with the other crops grown. Accounts are given of varietal trials, spacing, irrigation, and fertilizer experiments. The results of all the experiments are not yet complete. The following cotton pests and diseases are discussed: cutworms, lucerne caterpillar, American bollworm, spiny bollworm, jassid, alternaria leafspot, and cotton wilt.

104. SUDAN. *Ginning Factories*. (*Rpt. on Finan. Admin. and Condition of the Sudan in* 1930, recently received.) Of the nine factories which deal with the cotton crop of the country other than that from the Gezira, all but that at Yei showed a net profit on the season's working. The Yei factory has been closed down. The new factories at Port Sudan and Kadugli have been completed, and will deal with the crops in those areas.

105. TANGANYIKA. *East African Agricultural Research Station, Amani*. (*3rd Ann. Rpt.*, 1930-31.) Outlines of the work undertaken during the year are given in the progress reports of the Director, Plant Pathologist, Soil Chemist, Biochemist, Plant Physiologist, Plant Geneticist, Systematic Botanist, Superintendent of Plantations, and the Secretary and Librarian. The research work has made steady progress during the period under review, and the general equipment of the Station has been completed by the provision of a continuous and ample supply of electric current on the Sigi River.

106. UGANDA. *Cotton Prospects*. The latest report from the Department of Agriculture states that the advent of drier conditions in December has led to improvement in the crop. Stainers have caused considerable damage in the Lango, Chua, and Gulu districts.

107. WEST INDIES: SEA ISLAND COTTON. (*Trop. Agriculture*, ix., 1, 1932, p. 11.) The Sea Island industry is still in a serious plight, which has been aggravated by insect attack. With funds provided by the Imperial Government a cotton ginnery has been purchased by the Government in Nevis, which will be operated for the benefit of the peasantry. The question of holding a conference of cotton-growers has been receiving attention during the last few months.

108. St. Vincent. *Cotton Prospects.* The latest report received is to the effect that the crop does not look so promising as last year. A weak attack of cotton caterpillars was experienced, but was easily controlled. Stainers have made their appearance in one locality.

109. AUSTRALASIA: Queensland. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr. and Stock,* 1930-31, recently received.) The year saw substantial development in the cotton industry, due principally to satisfactory results from the first year's operations of the ginneries and oil mill by the Cotton Board, the suitability of the several varieties acclimatized by the Department, and the establishment of a spinning industry in Australia. The guarantee of the Government in a critical period in the history of the industry was a substantial stabilizing factor. The stimulus thus given would have produced an even greater crop but for abnormal seasonal adversity in the cotton-growing regions.

The standard of cultivation was generally lower than it should have been, although seasonal conditions made farmers naturally reluctant to risk the necessary expenditure. Where a good standard was maintained, however, the results amply justified the investment.

The work at the Callide Research Station was continued under very erratic weather conditions, but a nearly normal crop of seed was produced. Nineteen varieties of cotton were under investigation, and it is anticipated that when the present programme of work becomes fully effective a satisfactory solution of variety problems will be reached.

The chief pests and diseases encountered during the season were corn-ear worm, pink bollworm, stainers, rough bollworm, tip-boring caterpillar, and jassids. The occurrence of the last pest is most unusual, and is possibly correlated with the extremely mild temperatures existing through the past winter.

COTTON IN EGYPT.

110. The New Credit Bank. (*Int. Cot. Bull.,* x., **38**, 1932, p. 215.) This bank was established by Royal Decree in August last to meet such agricultural financial needs as are not covered by existing organizations. It will concern itself mainly with advances to co-operative societies and to small farmers, and with the sale of seeds and fertilizers to farmers. For these purposes short-term loans not exceeding 14 months will be granted. Longer-term loans, but for periods not exceeding 10 years, will be granted for the purchase of agricultural machinery and livestock and for the improvement of land by the construction of canals and drains. The capital of the bank is £E1,000,000, half of which sum has been subscribed by the Egyptian Government. The establishment of the Agricultural Credit Bank has been welcomed in Egypt as offering a permanent basis for assisting the small cultivator, and thereby contributing to the ultimate relief of the agricultural situation.

111. Old and New Varieties of Egyptian Cotton, 1931. By W. L. Balls and C. H. Brown. (*Int. Cot. Bull.,* ix., **36**, 1931, p. 700.) Breeding work in Egypt has quickly produced important results. Nearly half the Uppers crop of 1931 was grown from Giza 2 or "Ashmouni Gedid" cotton. Other cottons that are also very popular are Giza 3, grown in Southern Upper Egypt; Giza 7, which last year yielded 612 lb. of lint in trials conducted by the Agronomic Section; Sakha 4, which yielded higher on wilt-infested soil than did ordinary Sakel on healthy land. The deterioration of varieties due to contamination, especially with Hindi cotton, is discussed and illustrated by a number of diagrams.

112. Egyptian Cotton: Weeding out Poor Qualities. By C. H. Brown. (Egypt Suppt.: *Finan. News,* Jan. 25, 1932.) The work on cotton improvement in

Egypt by the Ministry of Agriculture is described under the heads of (1) the organization and methods used, and (2) the results obtained.

113. WHERE EGYPTIAN COTTON SCORES. By J. A. Todd. (Egypt Suppt.: *Finan. News*, Jan. 25, 1932.) An interesting article dealing with the supply, consumption, and prices of Egyptian cotton, and pointing out the dangers of excessive restriction.

114. WATER IN COTTON IN EGYPT. By W. L. Balls. (*Tech. and Sci. Serv., Bull. No.* 111, Min. of Agr., Egypt, 1931.) An investigation into the amount of water found in bales of Egyptian cotton under various conditions, submitted to the International Cotton Committee (Egypt) during 1928-30. The matter is dealt with under the following heads: The So-called "Natural Moisture Content"; The Remarkable Instability of Weight shown by Bales; The Cotton Content of Cotton Bales; Commercial Statistics for Bales.

115. THE NILE BASIN. By H. E. Hurst and P. Phillips. (*Phys. Dpt., Paper No.* 26, Min. of Agr., Egypt, 1931. Govt. Press, Cairo. Price P.T. 50.) A general description of the area, meteorology, and topography of the White Nile Basin.

COTTON IN THE UNITED STATES.

116. AMERICAN COTTON: STAPLE VARIATION. By O. G. Murphy. (*Arkwright J.*, i., 1931, p. 5. Abstr. from *J. of Text. Inst.*, xiii., **11**, 1931, A547.) The variation of staple length in eighteen bales—three from each of six States—of cotton classified as 1 inch has been determined. The results are tabulated and presented in chart form. Less than 50 per cent. of the cotton proved to be an inch or over in length, and 30 per cent. was $\frac{7}{8}$ inch or less.

117. AMERICAN COTTON: SUPPLY AND CONSUMPTION. By G. W. Fooshe. (*M/c. Guard. Comm.*, **23**, 1931, p. 276. Abstr. from *Summ. of Curr. Lit.*, xi., **21**, 1931, p. 596.) The causes of the persistent price falls in American cotton during the 1930-31 season are analyzed, and the influence of Government participation in the cotton market on the merchanting element is discussed.

118. AMERICAN COTTON: SUPPLY AND CONSUMPTION. By A. H. Garside. (*M/c. Guard. Comm.*, **23**, 1931, p. 279. Abstr. from *Summ. of Curr. Lit.*, xi., **21**, 1931, p. 596.) The changes in cotton values during the last two years are outlined, and the influence of efforts to maintain the price of cotton on the adjustment of supply to demand is pointed out.

119. FARM STUDY OF THE COTTON PLANT. By J. W. Hubbard. (*U.S. Dpt. Agr. Farmers' Bull.* 1661, 1931. Abstr. from *Exp. Sta. Rec.*, 65, **2**, 1931, p. 131.) The principal parts of the cotton plant and their growth habits and functions are described for growers.

120. HOW WE ESTIMATE THE (AMERICAN) COTTON CROP. By N. A. Olsen. (*Cotton*, M/c., xxxvii., **1789**, 1931, p. 21.) An interesting account of the methods used in forecasting. A useful instrument is the cropmeter, which is attached to an automobile and determines the frontage of crops to the roads. The estimate of acreage is also based on surveys covering about 120,000 farms.

121. THE RELATIONSHIPS OF THE NATURAL SCIENCES AND THE SOCIAL SCIENCES IN AGRICULTURAL EDUCATION IN THE UNITED STATES. By Dean W. C. Coffey. (*Sci.*, **95**, January 22, 1932, p. 92.) The author's contention is that not enough attention is paid to the social sciences, and that production is not all. He also draws attention to the great amount of productive land set free by the coming of the motor and its displacement of the horse. The article ends with the state-

ment: "Our agriculture needs a science to make us intelligent and efficient in our processes of production; on the other hand, it needs a science to make us intelligent and efficient in distributing our production, and adjusting it to the logical demand for it. If the amount of production greatly exceeds the demand for it, interest in intelligent and efficient production and the science underlying it is sure to sag." [These remarks dovetail well with those in Mr. Howard's paper in this number.—Ed.]

122. American Cotton Textile Institute: Activities. (*Text. World*, 80, 1931, p. 1594. Abstr. from *Summ. of Curr. Lit.*, xi., 23, 1931, p. 700.) The Institute has encouraged the elimination of night work for women and minors, and the standardization of hours to a maximum of 55 for day shift and 50 for night shift. It has also induced mills to reduce stocks and adjust production to demand, to adopt improved methods of costing, and to use arbitration methods for settling commercial disputes. The Institute has published an authoritative treatise on yarn costing, established a General Arbitration Council, and by means of cotton festivals and exhibitions has directed the attention of the public to cotton products.

123. Alabama. *Cotton Experiments.* (*Alabama Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 65, 5, 1931, p. 428.) In a study of factors affecting lint development in cotton, length of lint and size of boll were not affected by soil or climatic conditions, but were influenced by soil moisture. The soil moisture at or near the time of blooming markedly affected the size of boll, abundant moisture being associated with large bolls. The quantity of soil moisture present from 1 to 15 days after a flower appeared affected the length of lint produced by its boll, short lint being associated with a low moisture content at that period.

124. The Relation of Quality of Cotton to Prices Paid to Farmers in Alabama. By J. D. Pope and C. M. Clark. (*Bull.* 235, Agr. Exp. Sta., Alabama, 1931.) A study undertaken to determine the extent to which differences paid in central markets obtained in farmers' markets, and to determine whether or not an economic basis exists for the improvement of the quality of the cotton produced in the State. Improved yield gave better financial return than improved quality.

125. Arkansas. *Cotton Experiments.* (*43rd Ann. Rpt. Agr. Exp. Sta.*, 1931.) Describes cotton breeding, spacing, varietal, and fertilizer experiments. Field studies on the use of the tractor as a power unit in cotton production showed that each tractor displaced five work-animals on the average-sized farm. Studies on wilt resistance indicated a reduction of incidence with an increase of potash in potash-deficient soils.

126. Farm Prices of Cotton related to Quality, Arkansas Crop, 1928-29. By L. D. Howell. (*U.S. Dept. of Agr., Bur. Agr. Econ.*, 1931. Abstr. from *Exp. Sta. Rec.*, 65, 7, 1931, p. 684.) The variations in prices with quality and in average prices with average quality, and the influence of farm prices on quality of cotton produced, are analyzed for 14 local cotton markets of Arkansas.

127. Georgia. *Field Crops Work*, 1930. (*Ga. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 65, 2, 1931, p. 123.) Treatment of cotton-seed with an organic mercury compound greatly increased germination in early plantings, but not in medium or late plantings. Although cotton matured when grown in solutions prepared with distilled water and chemically pure salts containing nitrogen, potassium, calcium, magnesium, phosphorus, sulphur, and iron, plants grown in the same solutions with added traces of manganese, boron, copper, and zinc appeared more normal, had larger bolls, and a lower percentage of immature seed.

128. GULF SOUTH-WEST. *Cotton Production and Distribution.* By E. S. Moulton. (*U.S. Dpt. of Comm., Dom. Comm. Ser. No.* 49, 1931.) A detailed economic study under the following heads: Production of cotton; financing the cotton grower; farm ownership and tenancy; income from cotton; marketing of cotton; cotton-seed products industry; some problems of the cotton producers.

129. LOUISIANA. *Cotton Price-Quality Relationships in Local Markets.* By C. C. Farrington. (*Louisiana Sta. Bull.* 221, 1931. Abstr. from *Exp. Sta. Rec.*, 65, **5**, 1931, p. 484.) Data for the 1928-29 ginning season regarding prices, buyers' grade and staple designations, freight rates, shipping destinations, facilities, practices, charges, etc., from 10 local markets in Louisiana representative of different types of buyers' markets, were obtained by personal visits to co-operating ginneries.

130. MISSISSIPPI. *Plant Pathology at the Station.* By L. E. Miles. (*Miss. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 64, **7**, 1931, p. 641.) In seed treatment tests iodine with Bentonite proved the best disinfectant for cotton.

131. MISSOURI. *Cotton Production.* By B. M. King. (*Miss. Sta. Bull.* 299, 1931. Abstr. from *Exp. Sta. Rec.*, 65, **4**, 1931, p. 330.) From 16 trials, 2 to 4 plants in hills 10 to 12 inches apart averaged 424 lb. of lint per acre, and single plants in hills 12 inches apart 405 lb., and in hills 18 inches apart 377 lb. Applications of 400 lb. per acre of 4-12-4 fertilizer was the most effective treatment on land where black rust does not occur. Where cotton is normally seriously damaged by black rust 200 and 300 lb. per acre of 14 per cent. kainit gave marked yield increases. The most successful varieties were Delfos, Trice, Acala, Cleveland, and Express.

132. NEW MEXICO. *Agronomic Experiments.* (*New Mexico Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 65, **3**, 1931, p. 221). Cotton yields on adobe soil differed little, regardless of spacing, although unthinned cotton yielded about 17 per cent. less than that thinned to single plants 1 ft. apart. Topping did not increase yields appreciably. The stand, lint percentage, yield of bollies, and rate of maturity of cotton were about the same under either flood or furrow irrigation, although the total yields in furrow-irrigated plats were slightly larger. No legume was found satisfactory as a winter cover crop in cotton fields.

133. NORTH CAROLINA. *Plant Pathology at the Station.* (*N. Car. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 65, **2**, 1931, p. 145.) A total of 34 seed treatments were tested on cotton, and showed Ceresan and certain similar substances to increase materially the number of seedlings and to improve the uniformity of stand. In general, the results were such that 1·5 bu. of treated seed gave as good a stand as did 2 bu. of untreated seed. Delinted seed planted at Raleigh gave a poorer stand than undelinted seed when planted in April, but when planted in May the results were opposite.

134. SOUTH CAROLINA. *Cotton Marketing Studies*, 1925-30. (*S. Car. Sta. Bull.* 270, 1931. Abstr. from *Exp. Sta. Rec.*, 65, **2**, 1931, p. 188.) The importance and economic problems of production and marketing of the industry, the quality of South Carolina cotton, the factors affecting staple length and grade, the marketing processes, price in local and central markets, and the demands of South Carolina and United States mills are discussed.

135. *Cotton Research.* (*S. Car. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 64, **7**, 1931, pp. 628 and 644.) Studying factors which influence the growth and development of cotton buds and bolls, G. M. Armstrong and W. B. Albert determined that bolls of the first position on the branch, up to the age of 8 days, were higher in percentage of sugars, dextrines, and starches than comparable third position bolls of the same age. The contrasts were greatest between bolls 2 and 4 days old. The developing seed and lint of bolls at various ages was appreciably higher in percentage of sugars and starches than the boll walls or the pedicels and bracts except when the bolls were nearly mature, the highest percentages of sugars and starches being present when bolls were about 7 to 20 days old. There were no consistent differences in sugar and starch content of leaves adjacent to the above bolls. The walls of bolls of various ages were lower in sugars and starches than the growing seed and lint during the first 11 to 13 days; from then on the percentages of sugars and starches increased, and at the age of 40 to 45 days the boll walls contained higher percentages of sugars and starches than did the nearly mature seed and lint. The pedicels and bracts of young bolls contained lower percentages of sugars and starches than the seed and lint.

Cultural and fertilizer trials were carried out at the Pee Dee Station by E. E. Hall and S. J. Watson. Cotton broadcast with a grain drill, cultivated three times with a weeder, and hoed, produced 1,550 lb. per acre of seed cotton on a fertilized area and 1,166 lb. unfertilized. Sodium nitrate at the rate of 100 lb. per acre gave the greatest gain when applied 50 lb. at chopping and 50 lb. at first squares. Nitrogen carriers used as side dressers ranked in production of seed cotton in the order sodium nitrate, urea, ammonium sulphate, leunasalpetre, and calcium nitrate. In comparison of winter cover crops, hairy vetch and monantha vetch were outstanding in the production of nitrogen for cotton.

In seed treatment tests, Ceresan increased the number of plants per acre with acid-delinted and machine-delinted seed, and slightly with normal seed.

136. TEXAS. *Cotton Investigations.* (43*rd Ann. Rpt.*, 1930, received 1931.) Investigations are described in connection with the following. Root rot; ingestion of poison by, and hibernation of, the boll weevil; cotton flea hopper; pink bollworm (hibernation, flight studies, biology, cultural control, parasite control, etc.); fertilizer experiments; varietal tests; ginning; effect of radiation, etc. A local cotton marketing study showed that the average difference between local and central market quotations, for four local markets, varied from 2 to 11 dollars a bale. Mechanical harvesting was also investigated, and breeding of cotton varieties better adapted to it is being carried on. Ginning studies indicated that density of breast roll had more influence than speed of saws in determining the quality of the resultant lint and the manner in which the seed is cleaned.

137. THE TEXAS COTTON-GROWERS' FINANCE CORPORATION. By W. H. Rowe. (*U.S. Dpt. Agr., Bur. Agr. Econ.*, 1931. Abstr. from *Exp. Sta. Rec.*, 65, 7, 1931, p. 682.) This preliminary mimeographed report describes and discusses the characteristics of the corporation, types of loans, the measures of protection against loaning risks, the loan experience of the corporation, its rediscounts, interest charges and other costs to borrowers, and its income, costs, and profits.

COTTON IN FOREIGN COUNTRIES.

138. ASSOCIATION COTONNIÈRE COLONIALE. We have received a copy of *Bull. No.* 4, 1931, containing, among others, the following articles: "La chloropicrine pour le déparasitage des graines de coton" (J. Levy). This gas, which was largely employed in the war as a tear-gas, has proved very useful as a seed disinfectant. "Évolution de la culture du coton dans les États du Levant sous mandat français et exportations de fibres" (E. Achard). A useful and authoritative report. The Bulletin contains the usual notes on cotton-growing in Algeria, Sudan, Haute-Volta, Mauretania, Dahomey, Ivory Coast, etc.

139. Note sur les Travaux de Sélection dans une Station de Sélection Cotonnière au Congo Belge. By M. Waelkens. (*Bull. Agr. Congo Belge*, **21**, 1930, p. 800. Abstr. from *Plant Breed. Abstrs.*, ii., **1**, 1931, p. 31.) The equipment and methods of five stations are briefly detailed. Up to now the methods of breeding have been mass and pedigree selection. One station has reached the third, the others the second generation. A detailed description of the ideal type in view is given.

140. Notes sur le Coton dans le Haut-Oubangui Français. By R. L. Joly. (*Coton et Cult. Coton.*, 6, **2**, 1931, p. 115.) Gives reports on some of the cottons of this region, and expresses the view that greater unification of cultural varieties is desirable.

141. Japanese Textile Industry: Development. By S. Shibata. (*Proc. World Eng. Cong. Tokyo*, 1929, **28**, 1931, p. 113. Abstr. from *Summ. of Curr. Lit.*, xi., **24**, 1931, p. 732.) The development of the textile industry in Japan is described, and production figures are given for silk, cotton, woollen, linen, and rayon goods.

142. Peru. We have received from the Dept. of Overseas Trade a copy of the *Rpt. on the Econ. Conditions in Peru*, dated August, 1931 (W. M. Gurney). In regard to cotton, it is stated that Tanguis and Pima are the two varieties most extensively cultivated, comprising some 92 to 94 per cent. of the whole. The most noticeable feature of the buying season was the increased interest shown by Continental buyers, especially Germany. Improvements have been recorded in recent years in ginning and baling, and material progress has been made in combating the various cotton pests. There are some 25 mills in Peru engaged in the crushing of cotton-seed, the annual quantity handled exceeding 1,500,000 quintals. The industry is well organized, the entire output being marketed by the Union de Fabricantes de Aceite del Peru, a syndicate formed by the mill-owners, who pool their oil and receive a uniform price for it.

143. Russia. *Cotton Cultivation.* (*Int. Rev. of Agr.*, xxii., **12**, 1931, p. 770.) On December 1, according to Government instructions, 90 per cent. of planned cotton acquisitions for the year should have been made. Actually, however, only 57·7 per cent. had been made, against 62 per cent. last year. The Central Asiatic republics had executed 55·9 per cent. of the plan, Transcaucasia 70·5 per cent., and Kazakstan 68 per cent.

SOILS AND MANURES.

144. Cotton Plant: Manuring. (*Chem. Abs.*, **25**, 1931, p. 1937. From *Phosphorus Digest*, Feb., 1931, p. 2. Abstr. from *Summ. of Curr. Lit.*, xi , **16**, 1931, p. 440.) Complete mixtures prepared from potassium chloride and highly ammoniated superphosphate plus ammonium sulphate (when additional nitrogen was required) were compared with mixtures of similar analysis prepared from potassium chloride, ordinary superphosphate, and ammonium sulphate, as fertilizers for cotton in field tests. In 17 tests the ammoniated superphosphate mixtures gave an average yield of seed cotton 6·4 per cent. greater than that obtained with the ordinary superphosphate mixtures. The average yield of cotton obtained at the first picking was also higher from the plots fertilized with the ammoniated superphosphate mixtures. The ammoniated superphosphate used in these experiments was prepared by treating ordinary superphosphate with approximately 6 per cent. of anhydrous ammonia.

145. Cotton Plant: Effect of Mineral Fertilizers on. By I. F. Chernov. (*Chem. Abs.*, **25**, 1931, p. 4965. From *Khlop. Delo*, **9**, 1930. Abstr. from *Summ.*

of Curr. Lit., xi., **23**, 1931, p. 663.) Fertilizer experiments were conducted on twenty different kinds of soil with a single fertilizer element and a combination of two or three. The soils responded to nitrogen and phosphorus, but the best results were obtained with a complete fertilizer. A comparison of the various forms of nitrogen with superphosphate proved the superiority of potassium nitrate, which gave a 31 per cent. yield increase. Of the sources of phosphorus, double superphosphate proved the most economical, although precipitated phosphate was just as effective.

146. COTTON PLANT: EFFECT OF NITROGENOUS FERTILIZERS ON. By D. V. Kharkov and M. I. Lyakhov. (*Chem. Abs.*, **25**, 1931, p. 4961. From *Khlop. Nezavisimost*, **3**, 1931, p. 60. Abstr. from *Summ. of Curr. Lit.*, xi., **23**, 1931, p. 663.) In Middle Asia the best results were obtained with ammonium nitrate, followed by ammonium sulphate, oil meal, urea, and calcium cyanamide.

147. INTERPRETATION AND POPULAR PRESENTATION OF DATA, SHOWING THE ECONOMIC RESULTS OF FERTILIZATION. By H. W. Warner. (*J. Amer. Soc. Agr.*, 23, **4**, 1931. Abstr. from *Exp. Sta. Rec.*, 65, **6**, 1931, p. 517.) Ways of interpreting and presenting results of fertilizer experiments are described.

148. THE USE OF FERTILIZERS IN TROPICAL AND SUB-TROPICAL AGRICULTURE. By A. Jacob and V. Coyle. (Pubd. by Ernest Benn, Ltd., London, 1931. Price 10s. 6d. net.) This is a useful guide to the principles and practice of manuring in the tropics, and should prove helpful to beginners. The difficulties attending the work of the planter in the tropics render economy essential, and in order to practise true economy he must carry out experiments on his own soils with a view to determining the part played by each of the different plant foods in encouraging the growth of his crops under local conditions. The aim of this book is to guide the planter in this work, and therefore the opening pages of Part I. are concerned with the physiological importance of the various plant foods, with special reference to tropical plant-life. The following sections treat of the composition and formation of tropical soils, give detailed accounts of the methods of determining the requirements of the soil by exact manurial experiments, describe the most important fertilizers, and state general rules for their application. Part II. deals with the manuring of the following: grain, root, and leguminous crops, oil plants, sugar-cane, fibre plants, tobacco, tea, coffee, cacao, rubber, palm trees, fruit crops, and vegetables.

149. GREEN MANURING. (*Tech. Commn. No.* 22, Imp. Bur. of Soil Sci., Rothamsted, 1931.) This is a compilation which should be within reach of every worker with green manures. It contains a discussion of the important literature on all aspects of the subject divided under several heads: Green Manuring in Relation to the Mechanical and Physical Properties of the Soil; The Chemistry of Green Manuring; Relation of Green Manuring to Plant Diseases; Practical Utilization of Green Manures; Use of Fertilizers in Conjunction with Green Manures. A useful appendix gives a list of the plants used for green manures, and a bibliography of the subject is also included.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

150. RADIATION-INDUCED VARIATION IN COTTON: SOMATIC CHANGES INDUCED IN *G. Hirsutum* BY X-RAYING SEEDS. By W. R. Horlacher and D. T. Killough. (*Contr. Texas Agr. Exp. Sta. No.* 142, repr. in *J. of Hered.*, August 22, 1931, p. 253.) Cotton was found not to lose its power of germination under very heavy doses of X-rays. A noticeable effect is the production of many dwarf plants, often each with one terminal flower. Among other variations produced were types with one or with three cotyledons, with numerous variegations, with crumpled leaves, and with different leaf shapes.

151. COTTON SEEDS: DISINFECTION. By E. Tilemans. (*Chem. Abs.*, **25**, 1931, p. 3763. Abstr. from *Summ. of Curr. Lit.*, xi., **21**, 1931, p. 595.) A general discussion is given of the causes and effects of cotton diseases. Moist treatment with disinfectants shows that Uspulun and Abavit work positively, and Kalmit negatively, against sore-shin. In the United States the moist methods of treatment are giving way to dusting methods and the use of Ceresan. When Uspulun is used the seeds are soaked in a 0·25 per cent. solution of the disinfectant for 4 to 6 hours. The treated seeds have a more rapid germination and give stronger plants and a more homogeneous growth. To powder seeds with Ceresan, 50 kg. of seeds are shaken with 200 g. of disinfectant. This immunizes the seeds against diseases and outside contagions.

152. THE TECHNIQUE OF FIELD EXPERIMENTS: being the Report of a Conference held at Rothamsted in May, 1931. Among the various papers contributed were the following: "Principles of Plot Experimentation in Relation to the Statistical Interpretation of the Results" (Dr. R. A. Fisher); "Methods of Field Experimentation and the Statistical Analysis of the Results" (J. Wishart); "Technique of Variety Trials" (S. F. Armstrong); "Multiple Schemes of Field Experiments" (A. H. Lewis *et al.*).

153. THE ACCURACY OF COTTON LINT PERCENTAGE FIGURES. By J. R. Quinby and J. C. Stephens. (*J. Amer. Soc. Agr.*, 22, **2**, 1930. Abstr. from *Exp. Sta. Rec.*, 65, **7**, 1931, p. 631.) Ginning tests were made at the Chillicothe Substation, Texas, on 10-lb. samples from early, medium, and late pickings of 24 cotton varieties compared in 1928, and on 50 samples of 10 lb. and 30 lb., and on 50 200-gm. samples from a mixed bulk of Mebane cotton. The results indicated that when cotton is ginned in an experimental gin a representative sample of the entire plat production of seed cotton, or a composite sample of quantities in exact proportion to the yields of each picking, is needed for accurate figures for lint percentage, and consequently for acre yield. An 8-saw gin and a 20-saw gin ginned random samples from the mixed bulk of Mebane cotton with consistent accuracy, and the effect of errors in ginning upon the acre yield of lint cotton computed from plat yields was unimportant. One sample sufficed to give reliable acre yields of lint cotton when the samples were ginned on either gin, although the larger gin gave the more accurate result. With 10-lb. samples ginned on the 20-saw gin the probable error of a single determination was about 0·2 per cent. of lint, or 2 lb. of lint per acre, based on the yield of 1,000 lb. of seed cotton. In view of the differences in lint percentage between varieties shown in the 1927 tests, and the possible influence of fertilizer, soil, and seasonal conditions on lint percentage, there seemed little justification for interpreting results on the basis of seed cotton yields. Computation of lint percentage as the ratio of lint to clean seed cotton seemed more desirable than as the ratio of lint to raw cotton, since it avoided the effect of actual differences in the quantity of dirt and waste in the seed cotton as harvested.

154. PERCENTAGE OF LINT IN DISTRIBUTED PLATS OF COTTON VARIETIES. By J. R. Quincy and J. C. Stephens. (*J. Amer. Soc. Agr.*, 23, **1**, 1931. Abstr. from *Exp. Sta. Rec.*, 65, **7**, 1931, p. 631.) In the 1929 cotton variety test at the Chillicothe Substation, Texas, a 10-lb. sample was ginned from each of four distributed plats of 24 varieties. Assuming 33·3 per cent. of lint as a general mean for all varieties, the probable error was 0·270 per cent. of lint, slightly higher than the error of 0·2 per cent. of lint found above. Successive pickings of a variety were much more variable in percentage of lint than were total pickings from dis-

tributed plats of the same variety. Although the yields of the distributed plats of a variety varied considerably, lint percentage was relatively constant from plat to plat. In an experiment on comparatively uniform land, a lint percentage figure properly derived from ginning the production of a single plat may be applied without substantial increase in error to the replicated plats; or, when the seed cotton production of a single plat is below 10 lb. the seed cotton produced on two or more of the distributed plats may be massed and a representative sample drawn.

155. The Fowler Diesel "Gyrotiller." (*W. India Comm. Circ.*, xlvi., **863**, 1931, p. 429.) The "Gyrotiller" introduces an entirely new and greatly improved method of obtaining an unusually high degree of tilth in preparing the soil for planting crops. It is mounted on two half-tracks of the crawler type at the rear end, and at the front on a power-operated central steering wheel. Two sets of power-driven, horizontally rotating tillers are mounted at the rear of the machine, which, as it advances across the field, thoroughly stir and pulverize the soil from 12 to 16 inches deep. The "Gyrotiller" with one man operating will till, ridge and leave the land ready for planting at the rate of approximately one acre per hour, at a cost of 1 dollar.

156. Cotton Ginning Tests. By J. W. Carpenter. (*Miss. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 64, **7**, 1931, p. 681.) Experiments showed that the increased value of lint ginned with loose breast roll more than compensated for the decrease in capacity of the gin, which in some cases approximated to 50 per cent. Wet cotton or sappy cotton can be successfully dried either by sunning, by heated air, or by cold air which has been chemically dehydrated. Cotton was successfully dried by air which had been dehydrated by passing through calcium chloride.

157. Cotton Harvesting Development to Date. By H. P. Smith. (*Agr. Eng.*, 12, **3**, 1931. Abstr. from *Exp. Sta. Rec.*, 65, **7**, 1931, p. 676.) In a contribution from the Texas Experiment Station, a brief review of the status of cotton harvesting development is presented, with particular reference to mechanical methods. After considering all the various types of cotton harvesters, the conclusion is drawn that it is difficult for any and all types to handle the crop, since the nature of the cotton plant itself is largely responsible for retarding the development of a successful mechanical harvester. With this in mind, the station is attempting not only to develop a cotton harvester, but also to develop a variety of cotton which will be well suited to mechanical harvesting.

158. Cotton Seed Defibrating Apparatus. By A. G. Murdoch and British Cotton Seed Products, Ltd. (London). E.P. 353,358 of May 26, 1930. Abstr. from *Summ. of Curr. Lit.*, xi., **21**, 1931, p. 598.) In apparatus for defibrating cotton or other fibre-bearing seeds, the defibrating members are streamlined or approximately streamlined in the direction of their motions, and are formed or provided with teeth or serrations. The term "streamlined or approximately streamlined" refers not only to a perfect streamline formation, but also to elliptical or oval formations.

[*Cf.* Abstr. **262**, Vol. VIII.]

159. Paper from Cotton Seed. (*Ind. and Eng. Chem. News Ed.*, ix., **18**, **1931**. Abstr. from *Trop. Agriculture*, viii., **12**, 1931, p. 334.) A method for manufacturing paper from cotton seed has recently been elaborated in the Hyderabad State in India. The raw material is obtained from the by-products of the cotton seed crushing industry. The short fibres which may be recovered from cotton seed, when treated in a defibrating machine, can be used in the process, the yield of crude usable fibre amounting to about 4 per cent. of the total weight treated. The non-cellulosic materials contained in the crude fibre are first digested with caustic soda, under steam pressure of 30 to 40 lb. per square inch, followed by bleaching with bleaching powder or electrolytic chlorine. An alternative method, consisting of bacterial digestion of the impurities present in the raw material, has been found to replace effectively the chemical method of treatment, with a considerable reduction in cost. An estimate of the total costs of erecting and running a paper-making plant with a total daily capacity of about 10 tons is included. It is based on the chemical method of treatment.

160. LES DÉRIVES DE L'INDUSTRIE DU COTON DANS L'ALIMENTATION DU BÉTAIL. TOURTEAUX ET FARINES DE COTON. By E. Letard and F. Heim de Balsac. (*Coton et Cult. Coton.*, vi., **2**, 1931, p. 89.) A general account of cotton cakes and cotton starches, with analyses showing food values, etc.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

161. THE TREND IN ENTOMOLOGICAL ACTIVITIES IN THE COTTON STATES. By J. M. Robinson. (*J. of Econ. Ent.*, xxiv., **4**, 1931, p. 786.) The trend in entomological activities in the Cotton States today is toward improved facilities for fundamental research, more protection from introduced species of insects, better methods for the dissemination of insect control information through the extension entomologist, and improved and enlarged facilities for the training of entomologists in the various institutions of higher learning, particularly in the land grant colleges.

162. INSECTS CAPTURED BY AIRPLANE ARE FOUND AT SURPRISING HEIGHTS. By B. R. Coad. (*Yearb. U.S. Dpt. Agr.*, 1931, p. 320. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **11**, 1931, p. 633.) A brief outline of the results obtained in connection with investigations on the migration of insects, particularly those affecting the cotton crop, conducted by means of aeroplanes equipped with special insect collecting traps. A description is given of the trap. Collections were made at altitudes varying from 50 to 14,000 ft., the densest population being found to occur in the first 1,000 ft. Counts from several hundreds of collections, made in one locality in Louisiana, show that under all conditions for all seasons of the year an average of 25,000,000 insects is found in the upper air over one square mile of ground. Generally speaking, strong flying insects are collected closer to the earth, and smaller, weaker ones at higher altitudes. The cotton leafworm usually occurs within 3,000 ft. of the ground, the boll weevil has been found at 1,000 ft., the tarnished plant bug and pink bollworm up to 3,000 ft., the cotton flea-hopper up to 5,000 ft., leaf-hoppers up to 7,000 ft., and minute parasitic flies, aphids, etc., up to 14,000 ft.

163. INSECTICIDES, FUNGICIDES, AND DISINFECTANTS: PREPARATION. By A. Carpmael, London. (I. G. Farbenindustrie A.G., Frankfort, Germany. E.P. 360,405, 30/4/1930. Abstr. from *Summ. of Curr. Lit.*, xi., **24**, 1931, p. 721.) Describes the preparation of new compounds.

164. THE MEASUREMENT AND CONTROL OF ATMOSPHERIC HUMIDITY IN RELATION TO ENTOMOLOGICAL PROBLEMS. By P. A. Buxton. (*Bull. Ent. Res.*, xxii., **3**, 1931, p. 431. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **12**, 1931, p. 712.) The author describes a number of practical methods for the measurement and control of atmospheric humidity which may be of service to workers even in remote countries, including material already known to physicists, and other devices that can be used in small spaces and are portable. For the convenience of workers who have not access to libraries and collections of tabulated facts, a certain amount of information that is available in meteorological and physical tables has been included in graphic form.

165. LA CULTURE DU COTONNIER EN AFRIQUE DU NORD. By M. Widiez. (*Agr. prat. Pays chauds*, ii., **13**, p. 503. Paris, 1931. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **10**, 1931, p. 598.) *Earias insulana*, Boisd., which has been the principal cotton pest in French North Africa, has completely disappeared from cotton plantations in Algeria during the past two years, owing probably to the activities of its native parasites. Its bionomics and control, and the injury it causes, are discussed from the literature. Other pests include *A. gossypii*, *Oxycarenus hyalinipennis*, the beetles *Elater* sp. and *Rhizotrogus* sp., *Prodenia litura* and *Heliothis obsoleta.*

166. PESTS OF COTTON ON THE TAMAN PENINSULA. By V. V. Smolyannikov. (In Russian with summary in German.) (*Bull. N. Caucas. Pl. Prot. Sta.*, vi.-vii., p. 81. Rostov-on-Don, 1930. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **10**, 1931, p. 562.) During investigations on the pests and diseases of cotton in the Taman peninsula some 40 species of insects were found damaging the plants. The most important included the Tenebrionids *Opatrum sabulosum*, L., *Dasus pusillus*, F., and *Pedinus femoralis*, L., the weevil, *Psalidium maxillosum*, F., (?) *Agrotis tritici*, L., and *A. nigricans*, L., *Tetranychus telarius*, L., *Aphis gossypii*, Glov., *Loxostege sticticalis*, L., *Pyrausta nubilalis*, F., *Heliothis obsoleta*, F., and *Pseudococcus* sp.

167. PESTS OF COTTON IN THE SOUTH-WESTERN REGIONS OF THE UKRAINE ACCORDING TO OBSERVATIONS IN THE YEAR 1930. By D. V. Znoiko. (In Russian.) *Za khlopkov. Nezavisim*, **6-7**, 1931, p. 145. Abstr. from *Rev. App. Ent.*, Ser. A., xix. **12**, 1931, p. 729.) Among the pests mentioned are the following: *Euxoa tritici*, *E. segetum*, *Anisoplia segetum*, *Thrips tabaci*, *Aphis gossypii*, *A. euonymi*, *Myzus persicæ*, *Trifidaphis phaseoli*, *Tetranychus telarius*, *Heliothis obsoleta*, *Phytometra gamma*, *Scotogramma trifolii*, and *Loxostege sticticalis.*

168. CONSIDERAZIONI ENTOMOLOGICHE SULLA COLTURA DEL COTONE NELLA SOMALIA ITALIANA. By A. Chiaromonte. (*Communicazione al Congresso di Agricoltura Tropicale di Anversa*, Luglio, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **8**, 1931, p. 504.) The pests of cotton in Italian Somaliland discussed include the Eumolpid, *Syagrus rugiceps*, Lef., the larvæ of which do serious harm to the roots, often killing full-grown, vigorous plants; *Heliothis* (*Chloridea*) *obsoleta*, F., the larvæ of which attack the flower-buds and flowers, but are parasitized by *Sarcophaga* sp., *Sturmia inconspicua*, Mg., and *Gonia bimaculata*, Wied.; *Platyedra gossypiella*, Saund., which is the most injurious pest although it is not distributed in the seed, as the long cycle form does not occur, and the larvæ are parasitized by *Microbracon kirkpatricki*, Wlkn., and *Chelonella curvimaculata*, Cam.; *Dysdercus cardinalis*, Gerst., and *Oxycarenus hyalinipennis*, Costa, which are the most important of the Rhynchota, though the Jassid, *Empoasca facialis*, Jac., aggravates a condition of the plant due to other factors that results in the leaves curling or even falling.

169. BIOLOGY OF THE MEXICAN COTTON BOLL WEEVIL. By E. F. Grossman. "VI. Some Humidity and Temperature Effects on Development and Longevity." (*Flor. Ent.*, xiv., **4**, 1930. Abstr. *Rev. App. Ent.*, Ser. A., xix., **2**, 1931, p. 207.) Des cribes experiments undertaken to determine the optimum range of relative humidity necessary for successful hibernation in artificially cooled environments.

"VII. The Boll Weevil in Artificial Hibernation Quarters." (*Flor. Ent.*, xv., **2**, 1931. Abstr. *Rev. App. Ent.*, Ser. A., xix., **12**, 1931, p. 717.) Describes a new kind of cage in which various factors influencing hibernation of the boll weevil could be observed.

170. Notes on Some Hymenopterous Parasites of the Pink Bollworm. By T. Kanbe. (In Japanese, with Summary in English.) (*Ann. Agr. Expt. Sta. Korea*, v., **4**, 1931. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **9**, 1931, p. 514.) Seven species of Hymenoptera are parasitic on the pink bollworm (*Platyedra gossypiella*, Saund.) in Korea. *Pristomerus vulnerator*, Panz., has two generations a year, the adults appearing in the middle of May and again in early August. *Microbracon* sp., which is one of the most effective parasites, has three generations a year. The rate of parasitism is over 5·6 per cent.; it is higher on native cotton than on upland cotton, the maximum observed being 41 per cent. The female lays 2 to 11 eggs a day, usually 2 on each host, and from 40 to 50 during life. The larvæ hatch in 24 hours and mature in 7 to 8 days. *Habrocytus* sp., which is another important parasite, has 6 generations a year, and about 70 per cent. of the hibernating host larvæ were found to be killed by it. Another species of *Microbracon*, *Chelonella* sp., *Dibrachys cavus*, Wlk., and *Eurytoma* sp., are also parasitic in the larvæ. Parasites in Japan are *P. vulnerator* and *Pimpla* sp.

171. The Present Status of the Pink Bollworm in the South-West. By R. E. McDonald. (*J. of Econ. Ent.*, xxiv., **4**, 1931, p. 790.) Discusses the distribution, in 1930, of the pink bollworm (*Pectinophora gossypiella*, Saund.) in Mexico and the south-western part of the United States, and the intensity of the infestation in each area as revealed by the mechanical inspection of gin trash. The effect of low winter temperatures in a large part of the infested area on control of the insect is mentioned. The paper summarizes the efforts made to eradicate the rather heavy infestation discovered in the eastern end of the Salt River Valley of Arizona in the fall of 1929, by means of clean-up operations, a non-cotton zone, and delayed planting dates in the restricted zone, and details some of the difficulties encountered due to the subtropical climate of that area. The results of these efforts are reviewed, and the programme for the 1931 campaign is outlined. This provides for winter cleaning, ploughing, and irrigation of all cotton fields within approximately three miles of infestation, the prevention of growing volunteer cotton, and the delaying of planting until the peak of moth emergence has passed. Mention is also made of the scouting done in Mexico, in co-operation with the Mexican Department of Agriculture, to determine the distribution of the pink bollworm on cotton and wild host plants.

[*Cf.* Abstr. **519**, Vol. VII.]

172. Preliminary Report on Controlling Pink Bollworm in Texas by Winter Cultural Methods. By D. A. Isler and F. A. Fenton. (*J. of Econ. Ent.*, xxiv., **4**, 1931, p. 795.) Discusses the results of two years' work in Presidio, Texas, on the effects of ploughing and of irrigation as measures for pink bollworm control. The best control was obtained by thorough ploughing, followed as soon as practicable by irrigation.

[*Cf.* Abstr. **520**, Vol. VII.]

173. Pink Bollworm Scouting Methods. By R. W. White. (*Mon. Bull. Dpt. Agr. California*, xx., **6**, 1931, p. 363. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **10**, 1931, p. 616.) Field inspection methods in force in the cotton belt for discovering infestation by pink bollworm are described, and the advantages of the recently adopted method of gin trash inspection are pointed out. Details are given of a machine constructed to separate the bollworms from trash. This machine can only be used satisfactorily from the beginning of the ginning season until the first killing frost, after which the bollworms hibernate and are not found so readily in the trash.

In order to deal with that large portion of the cotton belt which cannot be covered during the favourable period, arrangements have been made for the collection of bolls when they are most liable to infestation, and their preservation until inspection is possible. Some 10,000 samples of 100 green cotton bolls each were collected from all States making up the cotton belt, and were examined in the laboratory by a method that is described in detail.

174. FIELD TESTS IN TEXAS OF INSECTICIDES FOR CONTROL OF THE COTTON BOLLWORM (*Heliothis obsoleta*, FAB.). By R. W. Moreland and F. F. Bibby. (*J. of Econ. Ent.*, xxiv., **6**, 1931, p. 1173.) Infestation by the cotton bollworm is not increased by the application of calcium arsenate or other insecticidal dusts to the cotton. In every plat treated with insecticides in these experiments there was a gain over its check in yield of cotton, whatever the poison used, and whether the number of applications was moderate or excessive. The difference in yield between plats treated with a commercial mixture consisting of 75 per cent. calcium arsenate and 25 per cent. Paris green, and plats treated with calcium arsenate alone, was so small that neither material can yet be regarded as definitely superior to the other. In some tests calcium arsenate gave slightly better results than the commercial mixture, whereas in others the reverse was true. The application of sodium fluosilicate dust to cotton gave but slight, if any, control of the bollworm in 1928. In 1929 the plat treated with this material yielded more cotton than the untreated plat, but not as much as the plat treated with calcium arsenate. Best results in cotton yield are obtained when the cotton is dusted regularly at proper intervals, beginning at the time the first brood of the bollworm appears. In the tests, the longer the first application was deferred the less was the gain in cotton yield, regardless of the advancement of the bollworm infestation at the time poison applications were begun. It does not seem advisable to defer applications too long, as the fruit set late in the season is likely to be prevented by frosts from maturing.

175. FACTORS INFLUENCING INFESTATION IN COTTON BY *Heliothis obsoleta*, FAB. By F. L. Thomas and E. W. Dunnam. (*J. Econ. Ent.*, xxiv., **4**, 1931, p. 815.) Experiments show that the proximity of corn to cotton has no relation to the infestation. Egg parasites, although valuable under some conditions, are not as important as the factors which influence egg deposition. Nectar and honeydew are shown to be unimportant. Throughout their growth the larvæ of *Heliothis obsoleta* show a desire for succulent food, and apparently must have it for normal development. Odours emanating from rapidly growing succulent cotton appear to be the most important factor influencing infestation of the plant by this pest.

176. CORN-EAR WORM IN QUEENSLAND. (*Queens. Agr. J.*, xxxvi., **2**, 1931, p. 195.) An article by J. Harold Smith, Entomologist, Dept. of Agr. and Stock, dealing with the pests of tobacco, contains an account of the life-history and habits of the Corn-ear Worm (*Heliothis obsoleta*, F.), which is also a serious pest of cotton. Illustrations are given in colour of the stages from emergence from the egg to full growth of the insect.

177. OBSERVATIONS ON THE COTTON NOCTUID (*Chloridea obsoleta*, F.) IN THE SLAVYANSK DISTRICT OF THE NORTH CAUCASIAN REGION. By B. V. Dobrovolskii. (In Russian.) (*Bull. N. Caucas. Pl. Prot. Sta.*, vi.-vii., p. 283. Rostov-on-Don, 1930. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **10**, 1931, p. 566.) In the course of observations on *Heliothis* (*Chloridea*) *obsoleta*, F., carried out in October, 1930, in a cotton-growing district in the Northern Caucasus, it was found that this pest chiefly concentrated in fields that had previously been attacked by *Loxostege sticticalis*, L., and in which the bolls had reached maturity earlier than usual owing to the defoliation of the plants. In such fields 74 per cent. of the bolls were damaged as compared with 20 per cent. in those that had not been infected

by *L. sticticalis*, and in which the plants were healthy, some of them still flowering.

178. The Corn-Ear Worm: Biology and Control. By L. P. Ditman and E. N. Cory. (*Bull. Maryland Agr. Exp. Sta.*, No. 328, 1931, p. 443. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **11**, 1931, p. 633.) A detailed account is given of the results of six years' work on the bionomics, seasonal history and control of *Heliothis* (*Chloridea*) *obsoleta*, F., on maize in Maryland. All stages are described, and characters distinguishing the sexes in the pupal stage are indicated, this not having previously been done for a Noctuid pupa. Natural enemies of the pest observed included various predacious Rhynchota, Coccinellids and Chrysopids, and the egg-parasite *Trichogramma minutum*, Riley. No satisfactory baits or repellants for the moths were found, and sprays of contact or stomach poisons proved valueless. Some control was obtained with dusts, particularly lead arsenate.

179. La *Diparopsis castanea*, Hmps. (Red, or Sudan Bollworm) sul Cotone a Barentu. By A. Chiaromonte. (*Agr. Colon.*, xxv., **7-8**, p. 343. Florence, 1931. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **12**, 1931, p. 686.) Descriptions of all stages with notes on the biology of this pest, and the injury caused by it in Eritrea, are given. Ploughing under of all debris after the cotton harvest is considered the best method of control.

180. L'Unico Bollworm del Cotone a Tessenei: *L'Earias biplaga*, Walk. By A. Chiaromonte. (*Agr. Colon.*, xxv., **4**, p. 165. Florence, 1931. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **8**, 1931, p. 471.) *Earias biplaga*, Wlk. (Spiny bollworm), the larva, pupa and adult of which are briefly described, is the only bollworm occurring on cotton in the Tessenei zone of Eritrea. It appears to have 3 to 4 generations a year, the life-cycle requiring about 35 days. The injury done is not serious. As cotton is the only food plant, the destruction of all cotton plants immediately after harvest is advised.

181. Spiny Bollworm Parasite. By J. Risbec. (*Compt. Rend.*, **193**, 1931, p. 247. Abstr. from *Summ. of Curr. Lit.*, xi., **19**, 1931, p. 525.) A parasite of the spiny bollworm has been found on cotton plants. The appearance of this parasite under the microscope and observations on its life-cycle are described. It feeds preferentially on fully-developed bollworms, particularly those which have started to spin their cocoons.

182. Devil's Shoe-String as an Insecticide. By V. A. Little. (*Science*, **73**, p. 1890, 1931. Abstr. from *Exp. Sta. Rec.*, 65, **6**, 1931, p. 547.) In work with the cotton aphid, devil's shoe-string (*Cracca virginiana*) was found slightly more toxic than pyrethrum, but less toxic than Derris.

183. The Control of the Cutworm. By H. Wilkinson. (*Bull. Dpt. Agr. Kenya*, No. 12, 1931. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **11**, 1931, p. 665.) Control by poison bait is recommended, and the method of preparing one of sodium fluoride and chopped prickly pear is given. The use of a bait of 1 lb. Paris green and 60 lb. bran has met with considerable success. Sufficient water should be added to make the mixture soft but not too moist, and it should be used in the late afternoon, about 20 lb. dry weight being required to the acre.

184. Notes on the Biology of *Laphygma exempta*, Walk., and *L. exigua*, Hbn. (*Lep. noctuidæ*). By J. S. Taylor. (*Bull. Ent. Res.*, xxii., **2**, 1931. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **9**, 1931, p. 536.) *Laphygma exempta* periodically causes serious damage to maize in the eastern Transvaal. *L. exigua*, which is chiefly a pest of cotton and peas, usually begins to cause injury to cotton early in January, and sometimes young plants are almost completely defoliated.

The lengths of the various stages vary considerably with the climatic conditions. Oviposition, which takes place at night, may begin three days after emergence. The eggs are laid on the leaves in clusters of 8 to 100, and hatch in 3 to 12 days. During mid-March to early April the larval period averages 18 days. Pupation occurs just below the surface of the soil, the pupal period lasting 9 to 48 days and the pre-pupal 2. In the insectary, females lived up to 15 days. The adult of this species is also believed to migrate. The most important parasites reared from the larvæ are a Tachinid and a Chalcid. Since infestation of cotton is most severe during the winter, when the parasites are least numerous, they are thought to play an important part in the control of this pest.

185. *Stomatorrhina lunata*, RD., PARASITE OF THE EGG-PODS OF THE MIGRATORY LOCUST, *Locusta migratoria*, L. By L. Y. Y. Skalov. (In Russian, with a summary in German.) (*Bull. N. Caucas. Pl. Prot. Sta.*, vi.-vii., p. 153. Rostov-on-Don. 1930. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **10**, 1931, p. 564.) In the autumn of 1928 egg-pods of *Locusta migratoria*, L., in certain areas of the Kuban Province, were found to be parasitized by the larvæ of *Stomatorrhina lunata*, F., in the case of one group to the extent of 95 per cent., 3 to 5 larvæ occurring in each egg-pod. The larvæ migrate from one egg-pod to another, and pupate in the autumn at a depth of about 2 inches in the ground. The adults emerge in 10 to 14 days, and are killed by the first frosts. Oviposition was not observed.

186. PRELIMINARY REPORT ON THE USE OF AEROPLANES IN THE CONTROL OF ACRIDIDÆ UNDER THE CONDITIONS OF CENTRAL ASIA. By Tzuigankov *et al.* (In Russian.) (*Khlop. Delo*, ix., **12**, 1366. Tashkent, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **8**, 1931, p. 465.) Experiments have proved that aeroplanes of certain makes may be effectively used for broadcasting moist or dry poisoned baits, the average width of the swath obtained being 160 feet, by flying at a height of 160 feet. Strips of dry bait in an open steppe are distributed very evenly, and in 6 hours it is possible to apply more than 6 tons of bait over an area of about 900 acres.

187. FLAME-THROWERS IN LOCUST (*Schistocerca gregaria*) CONTROL. By Khan S. Rahman. (*Agr. and Livestock in India*, i., **4**, 1931, p. 382.) Bodkin's flame-throwers were tried in the Punjab during April-May, 1930. The fuel employed was kerosene 60 parts, Diesel oil 30 parts, petrol 10 parts. The experiments proved that the destruction of hoppers resting among thick green hedges like *Agave* and *Euphorbia* cannot be properly and economically carried out by means of flame-throwers. Thick hopper bands resting on shrubs and bushes which either easily catch fire or allow the flame to penetrate into every part, or on medium-sized trees, can be effectively controlled by this method. The cost of working the flame-thrower varies, but even under the most favourable circumstances it is said to be very high compared with trenching and the use of poison baits.

188. CONTRIBUTION TO THE METHOD OF LOCUST CONTROL. By F. N. Lebedev. (In Russian, with a summary in German.) (*Bull. N. Caucas. Pl. Prot. Sta.*, vi.-vii., 1930, Rostov-on-Don. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **9**, 1931, p. 559.) Sodium arsenite proved to be the cheapest and most effective poison for spraying green vegetation. Good results were obtained by moistening cut grass or straw with a solution of this poison, 2 lb. sodium arsenite and 5 gals. water for each 50 lb. of grass or straw, and laying it out in long strips in the path of hoppers. This material can be used again where necessary. As a contact insecticide, caustic soda in the proportion of 1 lb. to 2½ gals. water is recommended.

189. USES FOR LOCUSTS. (*Crown Colonist*, January, 1932, p. 93.) The Kenya Department of Agriculture has been investigating the possibility of utilizing locusts as cattle and poultry foods, and as fertilizers. It is stated that sun-dried locusts, when finely ground, produce a concentrated foodstuff which is very rich in protein. The analyst considers that it would be highly advantageous to create an export trade in locust meal, or in a balanced meal of ground locusts and maize. A fertilizer worth from £5 to £6 per ton, in many respects well adapted to the rainfall and temperature of the Colony, could also be prepared from these insects.

190. FLOWERS OF SULPHUR AND THE PROBLEM OF THE CONTROL OF THE RED SPIDER IN CENTRAL ASIA. By S. K. Tzuigankov. (In Russian.) (*Za khlopkov. Nezavisim*, **6-7**, p. 66. Tashkent, 1931. Abstr. from *Rev. App. Ent.*, Ser. A., xix., 1931, **12**, p. 728.) A discussion of the use of flowers of sulphur for the control of the red spider, *Tetranychus telarius*, L., on cotton in Central Asia, and the factors responsible for its toxicity. It acts as a fertilizer stimulating the growth and development of the cotton plants, and does not injure them. Experiments have shown that the toxicity of the dust was increased when it was applied 2 to 3 days after the field had been irrigated. It is recommended to mix the sulphur with an equal quantity of lime, which must be freshly slaked in order to ensure an alkaline mixture, and apply it at the rate of 40 lb. of the mixed dust to the acre. Excellent results were also obtained with flowers of sulphur as a spray (1 to 5 lb. to 10 gals.).

191. *Stethorus punctillum*—A DESTROYER OF THE RED SPIDER. By S. Radzievskaya. (In Russian.) (*Za khlopkov. Nezavisim*, **6-7**, 1931, p. 75. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **12**, 1931, p. 729.) Descriptions of the eggs, larvæ, and adults are given. The larvæ and adults feed on all stages of *T. telarius*, showing a preference for eggs. They die in about two days if deprived of food. A table is given showing the number of mites and eggs consumed by individuals of each instar, and the process of regurgitation practised in feeding upon the mite is described. One larva consumes in the course of its life about 640 eggs and 160 adults of *T. telarius*.

192. PERU: EL "ARREBIATADO" DEL ALGODON EN PIURA (*Dysdercus ruficollis*, L.). By J. B. Pope. (*Mem. Estac. Expt. Agric. Soc. Nac. Agrar.*, **2**, p. 73. Lima, Peru, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **8**, 1931, p. 498.) An account is given of observations in the Piura Valley on *Dysdercus ruficollis*, L., which is of varying importance in different districts of Peru. A female lays 60 to 80 eggs during an average period of 13 days. The egg and nymphal stages average 8 to 45 days, and adult life 30. Females fed on bolls 40 days old produced almost four times as many eggs as those fed on bolls 20 days old, and adults placed with plants that had only begun to flower died without reproducing. For control, all cotton plants should be destroyed as soon as possible after the harvest, and the new crop sown at dates specified for the different localities.

193. INFORME DEL ENTOMOLOGO JEFE DE LA SECCION DE ENTOMOLOGIA. By J. Wille. (*Mem. Estac. Expt. Agr. Soc. Nac. Agrar.*, **2**, p. 63. Lima, Peru, 1930. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **8**, 1931, p. 497.) Cotton pests included *Dysdercus ruficollis*, L., and *Pinnaspis* (*Hemichionaspis*) *minor*, Mask., which causes enormous losses along the coast of Peru. A 10 per cent. oil emulsion is effective against this coccid, but its cost restricts its use to new foci of infestation.

194. THE BIOLOGY OF THYSANOPTERA WITH REFERENCE TO THE COTTON PLANT. VII. THE RELATION BETWEEN TEMPERATURE AND HUMIDITY AND THE LIFE CYCLE. By E. I. MacGill. (Reprinted from *Ann. of App. Biology*, xviii., **4**, 1931.) It is found that in the development of *T. tabaci* the degree of atmospheric humidity is of great importance in the question of the survival of the larva. At high temperatures a relatively high degree of atmospheric humidity (over 70 per cent.) is necessary if the insects are to reach maturity. Although temperature has a most marked effect on the length of the life-cycle of *T. tabaci*, the degree of relative humidity appears neutral, neither accelerating nor retarding the development of this insect.

195. *Frankliniella fusca* HINDS (THRIPS) ON SEEDLING COTTON. By C. O. Eddy and E. M. Livingstone. (*Bull. S. Carol. Agr. Exp. Sta.*, No. 271, 1931. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **12**, 1931, p. 716.) Experiments proved that infestation by thrips (*Frankliniella fusca*, Hinds) is capable of causing malformation and retardation of cotton seedlings, though it is difficult to determine the extent of damage in the field. Two forms occur in both sexes; in one the wings extend approximately to the end of the abdomen, and in the other barely to the first abdominal segment, being mere wing-pads. By selection five generations were necessary to segregate the short-winged form; though the long-winged one was reared through seven generations, it was never completely segregated. Fertilized eggs produced females and unfertilized ones males. Females laid about 30 eggs in 30 days. The incubation period averaged about 6 days, and subsequent development 10. *F. fusca* hibernates as an adult female in and around the roots or base of grasses and weeds where the winters are severe, and on various green plants where they are mild. The plants principally attacked at Clemson College are grasses, cotton, and onions, tobacco being a major food-plant where it is grown. Clean cultivation in and around cotton fields should be practised. Frequent applications of contact sprays will control *F. fusca*, but they cannot be used economically on cotton seedlings.

196. THRIPS (*H. indicus*) IN THE SUDAN. (*Rpt. on Finan. Admin. and Condition of the Sudan in* 1930, p. 98.) Definite advances have been made in the control of this pest in the Gezira. Further studies have shown that the main factors in the maintenance and rapid breeding of the species are a long pupal-resting period in the soil, the predominance of females and reproduction in the absence of males. The value of a vetch *Crotalaria* sp. as a trap plant for thrips has been established.

197. *Macrophomina phaseoli* (MAUB.), ASHBY, IN TRINIDAD. PT. I. PARASITISM. PT. II. PHYSIOLOGY. By J. West and W. R. Stuckey. (*Mem. Imp. Col. Trop. Agr. Trinidad* (Mycol. Ser.), **4**, 1931. Abstr. from *Rev. App. Mycol.*, x., **9**, 1931, p. 613.) *Macrophomina phaseoli* is not parasitic on cotton growing under normal conditions, but is a facultative parasite.

198. PARASITISME ET SYMBIOSE CHEZ LES APHIDES. By A. Paillot. (*C.R. Acad. Sci. Fr.*, cxciii., **5**, p. 300. Paris, 1931. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **11**, 1931, p. 643.) Normal bacterial infection in Aphids does not appear to lead to a serious pathological condition causing the death of the host. The parasitic bacteria of these insects are characterized by their extreme fragility. They usually stain badly, will not grow in the ordinary media used in bacteriology, and cannot infect other invertebrates. Hereditary transmission of bacteria is the rule in Aphids, although it occurs only exceptionally with most insects.

199. UN NOUVEAU PARASITE DUC OTONNIER A MADAGASCAR, *Xyloperthodes castaneipennis*, FAHR. By P. Vayssière. (*Rev. path. veg. Ent. agr.*, xviii., **6**, Paris, 1931, p. 215. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **12**, 1931, p. 734.) This Bostrychid is recorded as attacking cotton in Madagascar, where it has previously been observed on *Lagerstrœmia*, *Bixa orellana*, and *Mimosa*. Although it occurs on these bushes at all seasons of the year, it appears in the greatest numbers between April and November. On any of the plants attacked, branches 10 to 12 mm. in diameter are most subject to infestation. A circular tunnel 3 to 4 mm. in diameter is bored in the branch, immediately beneath the bark, and may penetrate further into the wood. Attacked branches become weak and break easily at the slightest jar, and the bolls on them fall without maturing. For control the branches should be cut just below the horizontal gallery after the position of the entrance hole has been exactly determined, and the cuttings burnt.

200. COTTON DISEASES. By A. A. Jaczewski. (*Bull. App. Bot. Genetics and Plant-Breeding*, xxiv., **5**, 1931. Leningrad. Abstr. from *Rev. App. Mycol.*, xi., **1**, 1932, p. 41.) Deals with the commoner diseases troublesome to cotton in the Russian plantations—viz., bacteriosis, wilt, root rots, and boll and lint rots. A bibliography of over 300 titles is included.

201. SULL' ARRICCIAMENTO DEL COTONE. By G. Paoli. (*Atti primo Cong. Studi colon., Firenze, April* 8 *to* 12, 1931. Abstr. from *Rev. App. Ent.*, Ser. A., xix., **12**, 1931, p. 731.) Leaf curl occurs in many plants, cotton in the tropics being specially affected. This paper discusses the occurrence of insects in relation to the disease in this crop in various parts of Africa. In Italian Somaliland it is produced by a Jassid, *Empoasca facialis*, Jac., the author's determination in this case having been confirmed by Jacobi. Examination of the genitalia is necessary for specific distinction in these insects, and in view of the fact that jassids have been considered in various regions to have no relation to cotton-leaf curl, the author investigated the identity of some African species. Examples from the Sudan, regarded as *E. facialis*, are said to represent an undescribed species of the same genus and a species of *Typhlocyba*. Leaf curl in the Sudan is not carried by these jassids, but an Aleurodid (*Bemisia gossypiperda*, Misra and Lamba). From the Belgian Congo, jassids identical with the Somali *E. facialis* were received from cotton, together with a few others, as yet unidentified, of the same genus. Jassids from Southern Nigeria also agreed with the Somali *E. facialis*, but leaf curl there is ascribed to an Aleurodid said by the present author to be of the genus *Bemisia*. Though a species of *Bemisia* occurs on cotton in Italian Somaliland, it is rare and not injurious, and it is difficult to understand why *E. facialis* in Nigeria does not cause leaf curl. Specimens from Rustenburg, Transvaal, agree fairly closely with Naude's description of *E. facialis* from specimens from Barberton where this disease is common, but are quite different from the Somali species.

202. THE INFLUENCE OF ENVIRONMENTAL CONDITIONS ON THE DEVELOPMENT OF THE ANGULAR LEAF-SPOT DISEASE OF COTTON. III. THE INFLUENCE OF AIR TEMPERATURE ON INFECTION. By R. H. Stoughton. (Reprinted from *Ann. of App. Biology*, xviii., **4**, 1931.) Experiments carried out in the Rothamsted control chambers on the influence of air temperature on the angular leaf-spot disease of cotton plants, resulting from spray inoculation of young plants, show that high air temperatures favour the development of the disease. Maximum infection occurs at an air temperature of 35 to 36° C. with decreasing incidence at progressively lower temperatures. At a constant air temperature of 39 to 40° C. cotton plants make no growth and eventually die. Infection takes place more readily when the inoculation is carried out during the non-illuminated period. The relation of these results to the experiments on the influence of soil temperature is discussed.

[*Cf.* Abstr. **89**, Vol. VI., and **103**, Vol. VIII.]

203. VIABILITY OF STRAND HYPHÆ OF THE COTTON ROOT-ROT FUNGUS. By D. C. Neal and L. G. McLean. (*J. of Agr. Res.*, 43, **6**, 1931, p. 499.) Viability studies of the cotton root-rot fungus, *Phymatotrichum omnivorum* (Shear) Duggar, in the conidial stage and with subterranean strands, are reported. Although no mycelial growth resulted from conidial germination, the strands permeating the spore-mats maintained their viability after prolonged periods of drying in open boxes in the laboratory, but their rather infrequent occurrence in cotton fields in Texas suggests that they play a negligible rôle in the over-wintering of the disease. In the experiments reported, strands of the fungus recovered at various depths from infested cotton fields proved viable as late as December 10, but excavations made during January, February, and March failed to reveal their presence, thus tending to eliminate them as an over-wintering possibility. The negative results obtained with strands indicate that the sclerotium is the important stage of the pathogene concerned in maintaining its viability from year to year.

204. INFECTION EXPERIMENTS WITH THE COTTON ROOT-ROT FUNGUS, *Phymatotrichum omnivorum*. By D. C. Neal and G. T. Ratcliffe. (*J. of Agr. Res.*, **43**, No. 8, 1931, p. 681.) Studies bearing upon the pathogenicity of the cotton root-rot fungus, *Phymatotrichum omnivorum*, were made during the season 1928-29 at two localities in Texas. Successful inoculations are reported with cotton plants grown in the greenhouse at a constant soil moisture, and with others grown under field conditions. The inoculum employed consisted of pure cultures of the fungus, cultures originating from the sclerotia found in the soil, sclerotia obtained in laboratory cultures, and conidial mats. With the exception of the conidial mats, the inoculum used produced infection in the plants both in the greenhouse and in the field, and in some cases caused the death of the host. Although many of the pure-culture inoculations, both vegetative and sclerotial, resulted in visible infection of plants in the pot experiments, some were erratic in behaviour, showing great variation in the minimum time required for initial infection.

205. THE SORE-SHIN DISEASE AND ITS CONTROL. By T. Fahmy. (*Tech. and Sci. Serv. Bull. No.* 108, Egypt. 1931. Govt. Press, Cairo. Price P.T. 5.) A description of the disease, its history, distribution and economic importance. The penetration of the parasite has been studied, and the effect of external conditions on the disease described. Experiments with different seed treatments are explained and the value of the results discussed. The most successful method of control is by sowing seed, previously soaked for forty-eight hours in water, in sufficiently moist land which has been brought to a fine tilth.

206. VIRUS DISEASES OF PLANTS AND THEIR RELATIONSHIP WITH INSECT VECTORS. By K. M. Smith. (*Biol. Revs.*, vi., **3**, 1931. Abstr. from *Rev. App. Mycol.*, x., **12**, 1931, p. 808.) A concise survey is given of all the plant virus diseases hitherto described, classified according to their hosts. An analysis is made of the various insect groups concerned in the dissemination of plant viruses, the number of virus diseases transmitted by each group being shown. The insects are broadly divided into two categories on the basis of their feeding method (biting or sucking). Those of the former group are shown to be implicated in the transmission of only three plant viruses, the remainder being disseminated by sucking insects—viz., Thysanoptera (*Thrips*) and Hemiptera-Homoptera (Tingidæ, Capsidæ, Jassidæ, Fulgoridæ, Coccidæ, Aleyrodidæ, and Aphididæ). The last-named have been shown to be involved in 27 cases, *Myzus-persicæ* alone being associated with 14 viruses. Discussing the evidence bearing on a possible obligate relationship between the virus and insect vector, the writer concludes that it is sufficient to warrant the assumption of such a relationship in certain cases. The available information on the factors of the relationship beween virus and insect vectors is also summarized and discussed. These include, amongst others, the incubation period of the virus in the insect vector; possible existence of disease or abnormality in insect vectors; longevity of the virus in the body of the insect vector; transmission of a virus by needle inoculation with the body juices of crushed infective insects; effect of sex or immaturity of the insect vector on its ability to transmit a plant virus; relationship of different individuals, strains, and varieties of insects to virus transmission; toxicity to the plant of an insect's saliva in relation to virus transmission; method of insect feeding in relation to virus transmission; apparent production of different symptoms when the same virus is transmitted by needle and insect respectively; numerical relation between infective insects and subsequent plant infection; dissemination of viruses from plant "carriers" by insect vectors; and transmission of plant viruses by soil-inhabiting insects. A bibliography of 247 titles is appended.

207. MILDEW FUNGUS CULTURE CELL. By T. R. Vernon. (*Ann. Bot.*, **45**, 1931, p. 733. Abstr. from *Summ. of Curr. Lit.*, xi., **24**, 1931, p. 722.) Describes a method for the close examination of the fine structure of the conidiophore and the arrangement and mode of attachment of the conidia of fungi.

GENERAL BOTANY, BREEDING, ETC.

208. PLANT-BREEDING: ITS PRACTICES AND SCIENTIFIC EVOLUTION. By F. L. Engledow. (*Sci. Jour. of Roy. Coll. of Sci.*, i., 1931, p. 74.) An excellent account of the methods and principles of scientific plant-breeding, touching upon most of the recent research work.

209. OLD AND NEW WORLD COTTON HYBRIDS: STERILITY. By S. Nakatomi. (*Japanese J. Bot.*, **5**, 1931, p. 371 Abstr. from *Summ. of Curr. Lit.*, xi., **21**, 1931, p. 619.) Experiments on interspecific hybridization between Old World and New World cottons are described. Although no work has hitherto been reported regarding the F_1 hybrid when a New World cotton was used as the female parent in the species hybridization of cotton, crosses were obtained using a New World cotton as the female parent. Development of the F_1 hybrid was much more vigorous than that of the parents, but perfect sterility was observed in the case of its self-fertilization, and even in that of back crosses or in that of fertilization with pollen of other varieties. Cytological studies of pollen mother-cells of the F_1 hybrid were made, and it was found that the chromosome behaviour in meiotic division was quite irregular. The perfect sterility of the F_1 hybrid was found to depend on the formation of abortive germ cells.

210. COTTON BOLL: SHEDDING. By A. V. Blagoveschensky. (*Bot. Centr.*, **18**, 1931, p. 331. From *Acta Univ. Asiæ Med.*, Taschkent, 1929, Ser. VIII*b*, Fasc. 10, 53S. Abstr. from *Summ. of Curr. Lit.*, xi., **17**, 1931, p. 489.) The causes of the falling of flowers from the stem are not clear. Zaitzev stated that shedding occurred first in the outermost flowers and attributed this to unequal nutrition in the upper and lower parts of the plant. The author's results confirm this conclusion. The water content is smaller in the upper leaves than in the lower leaves. The intensity of assimilation and also the content of carbohydrates and nitrogen is greater in the outer leaves than in the inner. The C/N ratio is higher in the outer leaves and similar to that in fallen bolls. A premature ageing thus appears to take place in the stems.

211. COTTON HAIR: DEVELOPMENT AND ELONGATION. By Wanda K. Farr. (Reprint from *Contr. Boyce Thompson Inst.*, **3**, 1931, p. 441. Abstr. from *Summ. of Curr. Lit.*, xi., **24**, 1931, p. 721.) Observations of the early stages of elongation of hairs from the seed-coat of *G. hirsutum* in mounts of fresh material show wide variations in hair length. The appearance of the cytoplasm indicates that growth initiation has taken place more recently in the shorter than in the longer hairs. The 32-fold increase in surface area of the seed during the first twenty days in comparison with the twofold increase in length of the transverse axes of epidermal cells during the same period, indicates that cell enlargement is not alone responsible for the tangential extension of the epidermal layer of the seed-coat. Large numbers of dividing cells in the epidermal layer from the date of flowering to the twelfth day following reveal the chief method of extension of the epidermal covering. A slight decrease in number of dividing cells after the twelfth day, and the presence of still fewer after the fifteenth day from flowering, suggest a progressive retardation in cell division which may begin as early as the tenth day. These observations are limited to median cross-sections of the seed and are not representative of the entire surface. Early stages of hair elongation from epidermal cells which are apparently daughter cells of recent divisions, furnish direct evidence that hairs may originate from cells which are not yet formed upon the date of flowering. The nutrition of the hair in any other fashion than through its basal connection with the seed seems to be quite unlikely. Median sections of the bases of hairs in all stages of development show neither extreme attenuation nor extreme constriction. An examination of bolls in all stages of development fails to reveal the presence of any liquid or semi-liquid substance in the boll cavity.

[*Cf.* Barritt's paper, p. 126 above.]

212. COTTON PLANT, ACCUMULATION OF MATTER BY. By A. V. Blagoveschensky *et al.* (*Bot. Centr.*, **18**, 1931, p. 330. From *Acta Univ. Asiæ Med.*, Taschkent, 1929, Ser. VIII*b*, Fasc. 4, 28S. Abstr. from *Summ. of Curr. Lit.*, xi., **17**, 1931, p. 489.) The energy of photosynthesis, the dry weight, and the contents of starch, sugar, nitrogen, phosphoric acid, and potassium oxide, were determined for *G. hirsutum* and *herbaceum.* The two types differ considerably in their physiological characteristics.

213. ROOT DEVELOPMENT AS RELATED TO CHARACTER OF GROWTH AND FRUITFULNESS OF THE COTTON PLANT. By F. M. Eaton. (*J. of Agr. Res.*, **43**, No. **10**, 1931, p. 875.) An examination of the root systems of cotton plants grown in cans containing 110 kg. of soil showed that root development was largely influenced by the character of the growth and the fruitfulness of the plants. Pima Egyptian and Acala Upland cotton plants were grown (1) normally, *i.e.*, with both branches and bolls; (2) with branches but no bolls, all floral buds having been removed as they appeared; and (3) with neither branches nor bolls, the lateral buds of the main stalk having been removed as they appeared. In the Pima series the mean ratios of the weight of roots to tops were 0·22, 0·53, and 0·57 respectively for the three treatments. In the Acala series the corresponding ratios were 0·17, 0·44, and 0·62. The data showed that the boll development of fruiting plants was dominant over both root development and vegetative growth. When plants were grown without bolls, the weight of roots increased proportionately more than the weight of tops, but the increase in weight of roots was approximately proportional to the increase in weight of stalks and branches. The weights of the roots of plants grown without bolls were approximately triple those of control plants. Little difference was found between the proportionate weights of the roots and tops of plants grown one in a pot and those of plants grown two in a pot. The ratio of the weight of the roots to the weight of the tops of plants allowed to wilt frequently was found to be slightly lower than the ratio of roots to tops of plants in a soil maintained as nearly as possible at an optimum moisture content.

214. COTTON PLANT ROOT SYSTEM, EXOSMOSIS FROM. By A. V. Blagoveschensky *et al.* (*Bot. Centr.*, **18**, 1931, p. 330. From *Acta Univ. Asiæ Med.*, Taschkent, 1929, Ser. VIII*b*, Fasc. 5, 128. Abstr. from *Summ. of Curr. Lit.*, xi., 17, 1931, p. 489.) Cultures were made in Hellriegel's solution, but using ferric citrate in place of ferric chloride. Greater additions of phosphoric acid cause a development of longer fibrils. On transference of the plants to distilled water for two days, exosmosis of nitrogen, phosphate, ferric oxide, and calcium was observed in all cases.

215. COTTON PLANT: TRANSPIRATION AND WATER REQUIREMENT. By B. S. Meyer. (*Chem. Abs.*, **25**, 1931, pp. 3031-2. From *Amer. J. Bot.*, 1931, p. 79. Abstr. from *Summ. of Curr. Lit.*, xi., **20**, 1931, p. 579.) The salts employed for the transpiration experiments with cotton in soil were sodium chloride, sodium nitrate, potassium chloride, potassium nitrate, calcium chloride, and calcium nitrate. The first four were applied to the soil in concentrations of 0·025, 0·05, 0·1, 0·2, and 0·4 per cent. of the soil; with the calcium salts an additional concentration of 0·8 per cent. was used. For 4-day periods addition of any of these salts in all the concentrations employed, with the exception of the lowest two concentrations of potassium nitrate, resulted in a decrease in transpiration as compared with plants growing in the soil to which no salt was added. Transpiration progressively decreased in amount with progressive increases in the concentration of any of these salts in the soil. The results were essentially the same whether transpiration was calculated on the basis of leaf area, fresh weight of the top or dry weight of the top. It is clear that the concentrations of salts employed with reference to the soil conditions used lie in the range where osmotic effects predominate over specific ionic effects. Sodium chloride in concentrations of 0·0125, 0·025, and 0·05 per cent. of the dry weight of the soil, and calcium chloride in concentrations of 0·0125, 0·025, 0·05, 0·1 and 0·2 per cent. of the dry weight of the soil were used in the water-requirement study. Cotton plants were allowed to grow under these treatments for 5 days, the usual technique of water-requirement studies being followed. The water requirement of the plants treated with sodium chloride decreased progressively with increased concentration of this salt in the soil. The lowest two concentrations of calcium chloride employed resulted in an increased water requirement; beyond that concentration the water requirement decreased progressively with increase in the concentration of calcium chloride in the soil. A progressive increase in the concentration of sodium chloride or calcium chloride in the soil resulted in a progressive increase in the final water content of the tops of the cotton plants.

216. SOME FACTORS CONCERNING EARLINESS IN COTTON By C. A. Ludwig. (*J. of Agr. Res.*, **43**, No. 7, 1931, p. 637.) There was little difference in the square-maturation periods of the five Upland varieties of cotton considered in this study. By comparison of the periods observed with those reported by other investigators for Upland and other types of cotton, it appears that the square period for this type is probably shorter than for Egyptian or for Sea Island cotton. The varietal differences in the boll periods were larger and reasonably consistent for the two years. This result is in harmony with the findings of other investigators, and indicates that relative length of boll period is dependent upon hereditary characters. The breeding of strains with especially short boll periods should be feasible. Comparison of the results with those previously reported indicates that Upland and Asiatic cottons have shorter boll periods than Egyptian and Sea Island cottons. Neither the amount of nitrate applied as fertilizer nor time of application had a perceptible effect on the square or boll period. Variations in the spacing of the plants had no appreciable effect on either the square or boll period except possibly a slight shortening of the boll period in wide-spaced plants, which was masked by the result of other influences. The earliness of the crop from close-spaced plants is due to other factors, and not to a shortening of the boll period. The usual cultivation period and a lengthened period produced an increase in square and boll periods over no cultivation. This may have been due to a genuine lengthening of the period or to an apparent lengthening caused by increasing the number of bolls which matured late in the season. Stripping forms from the plants had no perceptive effect on the square period. On the boll period, however, there was an apparent lengthening as the date of stripping was delayed. When the effect of time of the season was eliminated there was still no evidence of a shortening of the development period of forms produced on stripped plants. Stripped plants grew taller, produced more late blooms and bolls, matured a greater percentage of the late set bolls, and remained green longer in the autumn than unstripped plants. Cleveland and Webber 49-6 bolls, which required 45 days or more to open, reached their full dimensions in about 18 days. The resistance to puncture of the boll walls of the same two varieties increased from the time of blooming almost to maturity. At the opening of the boll there was a very great increase due to the drying out and hardening of the boll wall. The wall increased in thickness for a time, and then became thinner, even while the resistance to puncture continued to increase.

217. Cross Pollination in Cotton. (*Nature*, December 26, 1931.) A study of the frequency of natural crossing between adjacent varieties of cotton, for which de Vries coined the useful term " vicinism," has been made by Dr. M. A. Fikry (*Tech. Bull. No.* 18, Roy. Agr. Soc., Egypt). He planted strips of Red Leaf Acala cotton, which is homozygous for a dominant red leaf factor, in a field of Maarad cotton having green leaves. The plants are visited by insects, especially the honey bee and another bee of the genus *Nomia*, but wind is negligible as a factor in crossing. By making two pickings of Maarad seeds from successive ridges at increasing distances from the Acala, and determining the percentage of red seedlings in each case, the conclusion was reached that 4 per cent. of the seed from each plant in a cotton-field is crossed—that is, there is 96 per cent. of self-fertilization. A gradient of pollination, beginning with the source of pollen, gradually falls to zero at about 40 metres, which is the maximum range to which pollen was transmitted. The amount of vicinism will no doubt vary, depending especially on the frequency of insects and the distance between the plants, but the figures obtained are a measure of the precautions necessary to maintain purity in a cotton crop.

218. Pollen Tube Entry into Cotton Ovule. By G. S. Aiyangar. (*Agr. and Livestock in India*, i., 4, 1931, p. 471.) In the course of the examination of a one-day-old ovule in a withered cotton flower under the dissecting microscope, a small thread-like structure was found firmly attached to the micropylar end. A more detailed inspection revealed it to be a pollen tube. This observation was later on confirmed by the presence of similar tubes on a large number of ovules among the 7,000 ovules under study. These tubes were found to be quite intact even when the ovules were crushed and teased. It was also noticed that the absence of any remnant of a pollen tube at the micropylar ends of ovules of that age might be taken as a sure sign that the pollen tubes had not reached the ovules. Though the pollen tubes may be distinguished on an ovule with a dissecting lens, they will be more clearly seen when the ovules are examined under the low power of the microscope on a watch-glass containing a few drops of lactic phenol. Lactic phenol is a reagent that is generally used to stain protoplasm and pollen tubes in particular. It is made by adding 0·1 grm. of cotton blue to 100 c.c. of liquid made up of equal parts of distilled water, concentrated glycerine, lactic acid, and 1 per cent. of carbolic acid. A drop of glacial acetic acid added to a few drops of this, just before use, is very effective in making the pollen tube clearly visible.

219. Plant Respiration Katharometer: Application. By W. Stiles and W. Leach. (*Ann. Bot.*, **45**, 1931, p. 461. Abstr. from *Summ. of Curr. Lit.*, xi., **19**, 1931, p. 547.) Many difficulties and sources of error were encountered in an examination of the katharometer method of measuring plant respiration. Ways of dealing with them were devised, and an arrangement by which respiration may be accurately measured was elaborated. A detailed account of the method is given.

220. The Work of the Bombay Plant Breeders. By W. Burns. (*Agr. and Livestock in India*, i., **5**, 1931, p. 512.) A short sketch of the work of a group of plant breeders working in one province and on one crop. The outward and visible evidence of their success is the existence of certain varieties which are widely distributed, and are known and valued by the buyer, the broker, and the spinner. The principal strains dealt with in the article are Jayawant and Gadag I of the Southern Maratha Country, Banilla of the Khandesh Area, 1027 ALF and BD 8 of South Gujarat, Wagad of North Gujarat, 27 WN and 4 F of Sind.

221. The Genetics of Resistance to the Wilt Disease of Cotton and its Importance in Selection. By T. Fahmy. (*Tech. and Sci. Serv. Bull. No.* 95, Min. of Agr., Egypt., 1931, pubd. Govt. Press, Cairo. Price P.T.5.) The author states that the work is of a preliminary nature, and has no pretension to do more than put forward elementary information that may serve as a basis for future work on the subject. The wilt disease has been under scientific investigation for some forty years, but no detailed study of the genetic mechanism which regulates immunity to its attacks has hitherto been published. The subject is dealt with under the following heads: The heterogeneous nature of susceptible cotton varieties; The behaviour of plants towards infection; Immune and non-immune varieties; Testing of susceptibilities; The susceptibility of different varieties; The study of segregation and dominance; The selective action of the wilt disease in the field; The deliberate selection of immune types.

222. L'Amélioration du Coton Haitien par la Sélection. By R. H. Forbes and H. B. Barker. (*Bull. Serv. Tech. Dpt. of Agr. Haiti*, *No.* 16, 1930. Abstr. from *Plant Breed. Abstrs.*, ii., **1**, 1931, p. 30.) The local cotton consists largely of mixtures of four species. The selection work is carried out on *Gossypium vitifolium barbadense* which, among other desirable characters, possesses considerable resistance to fungous and insect attacks. In comparative tests some of these selections have surpassed all the best known foreign varieties, such as Pima, Sakel, etc., in quality and yield. The work of selection, beginning in 1927, is described. The objects are to obtain a high quality cotton capable of taking the place of Sea Island. The standards used for selection are enumerated —quality, percentage of fibres, yield and resistance being the main points; under quality are included length, texture, strength and colour. The origin and characters of a large number of lines are tabulated, and certain outstanding ones indicated. The first three selections have a fibre length of over 40 mm., are still segregating for texture, are strong, and give on the average 30 per cent. or more of fibre. The best of these has all the excellence of Sea Island; it is not quite fixed in all its characters, and further selection is expected to produce an extremely valuable type. It is described, and some very favourable expert reports upon it are given.

223. Methodics of Cotton Breeding Used at the Central Agricultural Experiment and Plant Breeding Station of Azerbaijan. By N. K. Yanushevsky. (*Proc. U.S.S.R. Congr. Genet. Plant and Animal Breed.*, **4**, 1930, p. 451. Abstr. from *Plant Breeding Abstracts*, ii., **1**, 1931, p. 30.) Selection is being performed on introduced varieties and hybrid populations for various component factors of yield and quality, which are enumerated Amongst these the chief are early ripening, size of boll, disease resistance, adaptation to poor cultural conditions, quantity, length, strength and uniformity of lint, oil content of seed. The various stages in selection are enumerated, followed by a list of the other numerous problems, including interspecific crossing and artificial induction of mutations, which the station is investigating.

FIBRE, YARN, SPINNING, WEAVING, ETC.

224. British Cotton Industry Research Association (Rpt of 12th Ann. Gen Meeting, 1931) In his speech the Chairman, Mr H P Greg, stated that since the meeting of a year ago the installation of machinery and equipment in the new experimental workrooms of the Shirley Institute had been completed. The Council were sincerely grateful to the many machine-makers who had made very generous gifts and equally generous loans of machinery to the Institute, some of the machines being specially made to respond to special requirements. An account of the work of the year was given by the Director of Research, Dr R H. Pickard, who stated that some 1,500 enquiries had been received and dealt with during the period

225. Cotton Moisture Relations By H H Willis (*Cotton*, U S, **95,** 1931, p 821 Abstr from *Summ of Curr Lit*, xi, **19,** 1931, p 543) Reference is made to a large series of tests of moisture content of raw cotton at various stages in the mill, and to laboratory tests The factors discussed with the help of curves are (1) influence of type, (2) influence of bleaching and heating, and (3) rate of regain Reference is also made to regain as a factor in tensile testing

226. Raw Cotton, Yarns, and Cloths Moisture Regain By W B Hodge (*Arkwright J*, **1,** 1931, p 17 Abstr from *Summ of Curr Lit*, xi, **18,** 1931, p 516) The results of regain determinations on samples of raw cotton, yarns, and cloths collected from 38 yarn mills and 57 cloth mills are tabulated The average regain of the raw cotton in the yarn mills was 8 92 per cent and in the cloth mills 8 94 per cent The average regain of the finished yarn as shipped from the yarn mills was 5 37 per cent and of the finished yarn in the cloth mills 4 73 per cent The average regain in the finished cloth as ready for shipment was 6 6 per cent The average regain of finished yarn in yarn mills where humidifiers were running was 6 95 per cent, and in mills where humidifiers were not in operation or not installed in the finishing department 4 44 per cent The average regain of finished cloth in mills where humidifiers were running in the cloth room was 7 58 per cent, and where humidifiers were not running 5 67 per cent During the course of the investigation it was noted that samples of sheeting of identical construction, at a temperature and humidity that represented 11 per cent regain, varied through the effect of the sizing alone from 13 4 to 8 6 per cent regain

227. The Deterioration of Fabrics Exposed on a Roof after Treatment with Fishing Net Preservatives By W R G Atkins (*J Marine Biol Assoc*, N.S, xviii, **2,** 1931 Abstr from *Rev App Mycol*, x, **11,** 1931, p 733) In connection with investigations on the deterioration of linen and cotton fabrics exposed for two years on a roof at Plymouth after treatment with fishing-net preservatives, attention is again drawn to the excellence of cuprinol, a copper soap of a petroleum acid, as a protective against bacteria and moulds. The weakening of the fabrics, which lost one- to two-thirds of their initial strengths both in warp and weft, is attributed principally to the action of light.

228. PARACHUTE SUSPENSION FABRIC: CONSTRUCTION. By M. E. Bourgeois. (Paris). (E.P., 359,580 of 3/7/30. Abstr. from *Summ. of Curr. Lit.*, xi., **23**, 1931, p. 676.) Tubular woven fabric for parachute suspension elements and similar purposes, in which a definite calculable strength coupled with light weight is desirable, is composed of straight threads extending lengthwise of the fabric, of a thickness and number suitable to resist breaking-point, and maintained in place by a thread of less resistance interwoven with the straight threads, and arranged in the manner of a weft thread having a helicoidal path about the straight threads.

229. MILDEW STAINS: REMOVAL. (*Leipziger Monats. Tex. Ind.*, **46**, 1931, p. 223. Abstr. from *J. of Text. Inst.*, xxii., **11**, 1931, p. 538.) Various methods are recommended, including the use of the proprietary product "Omicide," with a solution of which the stained cloth is treated for 10 to 30 minutes in a wooden vessel at a temperature not higher than 30° C.

230. METHODS OF ESTIMATING COTTON FIBRE MATURITY. By R. S. Hawkins. (*J. of Agr. Res.*, **43**, No. 8, 1931, p. 733.) The extent of fluffiness in the cotton is indicative of the amount of immature fibres present, and can be utilized to a certain extent in evaluating cotton from this standpoint while it still remains unharvested in the fields. The colour, plumpness, and maturity of a representative quantity of the delinted seed is also indicative of the percentage of immature fibres borne by the seed, dark-coloured, plump, well-developed seed being correlated with a high percentage of mature fibres, and conversely, light-coloured poorly developed seed is associated with a high percentage of immature fibres. High concentrations of soil alkali, a comparatively low supply of soil moisture, and early frosts are contributing factors in the production of high percentages of immature fibres. The last picking usually contains the greatest amount of immature fibres. Distinct varietal differences in fibre maturity are common.

231. COTTON HAIR: STRUCTURE. By R. Haller. (*Helv. Chim. Acta*, **14**, 1931, p. 578. Abstr. from *Summ. of Curr. Lit.*, xi., **17**, 1931, p. 486.) Cotton hairs were oxidized by treatment with bromine water, sodium hypochlorite, potassium permanganate, hydrogen peroxide, chlorine water, and chromic acid, and the products were examined under the microscope after treatment with sodium hydroxide, stannous chloride and tetrachloroauric acid, cuprammonium hydroxide, and other reagents. The structures observed are described and are contrasted with those obtained by similar treatments of cellulose obtained by the saponification of cellulose acetate. The observations confirm the existence of concentric layers in the cotton hair as described by Hess, and indicate that the outer layers and the separating membranes are preferentially attacked by oxidizing agents. The breaks perpendicular to the fibre axis produced by oxidizing agents do not, however, correspond with the membranes perpendicular to the axis postulated by Hess. It is suggested that the spiral structure of the cotton hair is due to the shrinking produced by the drying process which follows the withering of the protoplast.

232. THE FRICTIONAL PROPERTIES OF COTTON MATERIALS. By J. A. Morrow. (*J. of Text. Inst.*, xxii., **9**, 1931, p. 425.) Gives the results of a large number of measurements of hair and yarn friction, together with a summary of experiments on cloth friction. The paper is divided into three sections, dealing with the friction of hair upon hair, and of yarn and cloth against various surfaces.

233. COTTON MILL: HUMIDIFICATION. By H. H Willis. (*Cotton*, U.S., **59**, 1931, p. 821. Abstr. from *Summ. of Curr. Lit.*, xi , **19**, 1931, p. 545.) Reference is made to a series of tests from which the author concludes that the best conditions of humidity are as follows: blowroom, 45 to 50 per cent.; cardroom, 55 to 60 per cent.; spinning-room, 65 to 70 per cent. The advantages of controlled humidity are stressed.

234. COTTON ROPES AND TWINES: MANUFACTURE AND POWER TRANSMISSION BY. By P. Kenyon. (*M/c Guard. Comm.*, **22**, 1931, p. 481. Abstr. from *J. of Text. Inst.*, xxii., **8**, 1931, A415.) A general article, including an account of the production of cotton string and ropes, and a table showing the power that can be transmitted by ropes ranging in diameter from 1 to 2 in. on average drives at velocities of 1,000 to 5,000 ft. per minute.

235. COTTON DRIVING ROPE: ADVANTAGES. (*Text. Mfr.*, **57**, 1931, p. 120. Abstr. from *J. of Text. Inst.*, xxii., **8**, 1931, A415.) As a result of a recent accident, it has been stated that the use of cotton ropes for lifting purposes is undesirable. In reply to this statement it is pointed out that amongst superior properties over manila, hemp, or sisal ropes, the cotton rope can claim more than three times the true elasticity, and a durability double or more working under the same conditions. Wear in a cotton rope usually takes place first on the outside, which is not the case with a manila rope. Cotton is probably less sensitive to bacteriological, mildew, or chemical tendering, though it may well be that any textile rope should be protected against repeated impregnation by such a substance as lime.

236. COTTON-BOLL SORTING AND CLEANING MACHINE. Soc. Alsacienne de Constructions Mécaniques (Mulhouse, France). (E.P. 355,855 of 11/6/29 and 355,934/5/6 of 5/2/30. Abstr. from *Summ. of Curr. Lit.*, xi., **20**, 1931, p. 558.) The patent relates to a machine for separating, prior to ginning, the more or less completely ripened or developed cotton bolls so as ultimately to obtain several homogeneous qualities of fibre, and for effecting preliminary loosening and cleaning of the bolls to facilitate the work and increase the efficiency of the gins.

237. "F.7 FEEDER" COTTON OPENER. Saco-Lowell Shops, Boston. (*Text. World*, **80**, 1931, p. 694. Abstr. from *Summ. of Curr. Lit.*, xi., **18**, 1931, p. 503.) This new machine for opening, cleaning, and blending cotton is constructed of steel, except for the wooden laths, leather belting and canvas aprons. The hopper is entirely enclosed and the top is fitted with a dust-extractor fan. Inside is a sensitive rake motion which operates a green light when the cotton has reached a predetermined low level, or a red light when sufficient cotton is present.

238. COTTON SCUTCHING AND CLEANING MACHINE. By J. F. Schenck, jun. (Shelley, N. Carolina, U.S.A.) (E.P. 353,217 of 2/7/30. Abstr. from *Summ. of Curr. Lit.*, xi., **17**, 1931, p. 479.) The patent relates to apparatus for use in connection with cotton scutching and cleaning machines for effectively separating impurities, particularly dried leaf, from the cotton. The machine comprises a roller, preferably clothed with wire, which rotates against the periphery of the beater casing between the uppermost grid bars (those first swept by the beater) and the lowermost, together with a partition, of which the upper edge is in close proximity to the roller and a brush rotatable against the roller on the opposite side of the partition from the beater casing. The roller and partition thus form partition means to prevent the particles of dirt, which are driven by the air-blast created by the beater between the uppermost grid bars and removed by the roller, from being drawn back into the beater casing by the suction created by the beater between the lower grid bars.

239. COTTON SCUTCHING AND OPENING MACHINES. By F. Quinn and L. Wild, (Bolton). (E.P. 354,316 of 7/5/30. Abstr. from *Summ. of Curr. Lit.*, xi., **19**,

1931, p. 530.) The mixed sand, leaf, stalk, neps, and like impurities which are associated with a certain amount of fibre are collected after delivery through the usual grid by means of a slow-motion lattice, and delivered through feed rollers on to a high-speed saw-tooth roller or cylinder, in conjunction with which is arranged a suction chute having a blade or blades at its entrance end adjacent to the periphery of the saw-tooth roller or cylinder, as described in E.P. 218,877. In this way a very thorough separation of the fibrous material from the impurities is effected, the separated fibre being subsequently returned at the surface of the bottom dust cage of the machine to the main stream of fibre passing through the machine.

240. AUTOMATIC LOOM: ADVANTAGES. By M. Procter-Gregg. (*Text. Weekly*, **7**, 1931, p. 239. Abstr. from *J. of Text. Inst.*, xxii., **9**, 1931, A462.) The writer questions the figures given in a previous paper, and compares the cost of weaving Burnley printers on the ordinary Lancashire loom system with four looms per weaver, and on the Northrop automatic system with forty-eight looms per weaver, and gives other data. The saving obtained with the automatic system is estimated at 2s. per piece. The economies of the ring frame and the advantages of rewinding the weft in conjunction with larger shuttles and slower speeds for ordinary looms are briefly discussed.

241. AUTOMATIC LOOMS AND ATTACHMENTS: COSTING. By W. A. Hanton. (*Text. Weekly*, **7**, p. 789, and **8**, p. 9, 1931. Abstr. from *J. of Text. Inst.*, xxii., **11**, 1931, A528.) A discussion of the costs of producing cloth on fully automatic looms and looms with attachments. The author makes out a case for the more-looms-per-weaver system as well as for fully automatic looms. Compared with the latter, the attachments are said to give about the same cost of weaving with half the capital expenditure, but with less satisfactory running and more faulty cloth.

242. AUTOMATIC WEFT-REPLENISHING LOOM. By W. W. Triggs, London. (Crompton and Knowles, Worcester, Mass., U.S.A.) (E.P. 356,761 of 11/3/30. Abstr. in *Summ. of Curr. Lit.*, xi., **24**, 1931, p. 713.)

243. TOYODA AUTOMATIC LOOM: DEVELOPMENT. By K. Toyoda. (*Proc. World Eng. Cong. Tokyo, 1929*, 1931, **28**, pp. 151-69. Abstr. from *Summ. of Curr. Lit.*, xi., **24**, 1931, p. 709.) Industrial conditions in Japan and other countries are compared, and development of automatic looms adapted to Japanese conditions are discussed. The history of the Toyoda loom is outlined.

244. LANCASHIRE LOOM: ADAPTATION. By W. A. Hanton. (*Text. Weekly*, **7**, 1931, pp. 651, 677, and 729. Abstr. from *J. of Text. Inst.*, xxii., **11**, 1931, A529.) An inquiry into the effects on costs of rewinding weft, using larger bobbins, and allocating more looms to the weaver, made with the idea of indicating how to "make the most of the ordinary loom."

245. SHUTTLELESS LOOM. British Celanese, Ltd. (London), *et al.* (E.P. 344,915 of 9/12/29. *J. of Text. Inst.*, xxii., **9**, 1931, A439.) The patent relates to a shuttleless loom in which a single pick length of weft is introduced into the shed by a dummy shuttle in the form of a loop connected to a preceding pick, the loom comprising means operated by the shuttle in its passage through the shed to sever the weft from the preceding pick when the loop has reached a length from the point of severance sufficient to complete a single pick, and to leave an end of the preceding pick turned into the shed. The means operated by the shuttle to sever the weft are actuated electrically by the passage of the shuttle across the reed.

246. Marktbeobachtung und Absatzorganisation in der Deutschen Baumwollweberei. By Dr. Otto Bickel. (Pubd. Krische and Co., Nurnberg, 1931. Abstr. from *J. of Text. Inst.*, xiii., **10**, 1931, p. 163.) A description of the German cotton-weaving industry.

TRADE, CO-OPERATION, ETC.

247. Cotton Fabrics: New Uses. Cotton Textile Inst., U.S.A. (*Text. Weekly*, **79**, 1931, p. 2687. Abstr. from *J. of Text. Inst.*, xxii., **10**, 1931, A482.) The new uses being considered are for wrapping gas mains, tennis court construction, net bags for fruit and vegetables, men's summer suits.

248. Cotton Canvas: Application in Shipbuilding. (*Text. World*, **80**, 1931, p. 217. Abstr. from *Summ. of Curr. Lit.*, xi., **17**, 1931, p. 480.) An account is given of the refitting of the old frigate *Old Ironsides* with 22-inch cotton canvas sails. The full spread of sails totals 12,500 sq. yds. It is pointed out that a modern liner consumes about 15,000 sq. yds., and a battleship about 20,000 sq. yds. for deck coverings, awnings, flue covers, life-boat covers, and so forth.

249. Cotton: Prices. (*Spinn. v. Web.*, 49, **46**, 1931, p. 2. Abstr. from *Summ. of Curr. Lit.*, xi., **24**, 1931, p. 732.) Methods of forecasting raw cotton prices are outlined, and price movements since 1821 are discussed. The existence of 56-year cycles is pointed out.

250. Cotton: Production and Price Records. By J. A. Todd (*M/c Guard. Comm.*, **23**, 1931, p. 261. Abstr. from *Summ. of Curr. Lit.*, xi., **21**, 1931, p. 597.) The price variations of raw cotton are discussed, and it is shown that all the low levels coincide with record crops.

251. Exported Cotton Piece Goods: Prices. By B. Ellinger. (*Text. Weekly*, **8**, 1931, p. 140. Abstr. from *Summ. of Curr. Lit.*, xi., **22**, 1931, p. 661.) An analysis is made of exports between 1923 and August, 1931, under the headings: (*a*) Total, (*b*) grey, (*c*) bleached, (*d*) printed, and (*e*) dyed. The latest average prices compared with 1913 show the following increments: (*a*) 64 per cent., (*b*) 32 per cent., (*c*) 28 per cent., (*d*) 94 per cent., and (*e*) 70 per cent. Japanese prices are also discussed, and it is calculated that the following figures reflect the averages for 1930:

	Greys.	*Whites.*	*Prints, etc.*
England	4·1	4·9	8·2 pence per yard.
Japan	4·0	4·4	4·8 ,, ,,

A fall in selling price of 25 per cent. would enable Lancashire to compete with Japan in greys and whites, but in dyed and printed lines a fall of 58 per cent. is necessary. The latter figure suggests that Lancashire and Japan are now catering for different markets in printed goods, and that some new organization is necessary if Lancashire decides on a policy of recapturing the cheap trade.

252. Industrial Engineering as Related to Costs in the Textile Industry. By J. E. Goudey. (*Canad. Text. J.*, **48**, No. 12, 1931, p. 17. Abstr. from *J. of Text. Inst.*, xxii., **8**, 1931, A420.) An outline of the factors involved in obtaining an efficient knowledge of costs, especially as regards the standardization of work, wages, and production, direct and indirect labour, depreciation and overhead expenses, and machinery valuations.

253. Baumwolle auf Zeit. By T. Buhler. (Pubd. Krische and Co., Nurnberg, 1931. Abstr. from *J. of Text. Inst.*, xxii., **10**, 1931, p. 162.) Deals, from the German standpoint, with the principles of trading in Futures. The glossary of English and German technical terms should prove useful to those interested.

MISCELLANEOUS.

254. Report by Mr. F. A. Stockdale, C.B.E., Agricultural Adviser to the Secretary of State for the Colonies, on his Visit to South and East Africa, Seychelles, the Sudan, Egypt, and Cyprus, 1930-31. (C.A.C. 75.) A very interesting report which should be studied by all in charge of departments or institutions dealing with any form of tropical agriculture. Among the recommendations made are some for the dissemination of results of research within a department, based on the methods employed at the South African Veterinary Station. An interesting account is given of cotton in Uganda, and also one of the Agricultural Conference at Amani. In the concluding remarks attention is drawn to the great variety of leguminous plants in East Africa that are suitable for cover crops, and also to its wealth of millets.

255. Report of Department of Scientific and Industrial Research, 1930-31. (Cmd. 3989. Pubd. H.M. Stat. Off., 1931. Price 3s. net.) The Sixteenth Report contains a general review of the work carried out under the supervision of the Boards and Committees of the Department, together with a section describing the work of Research Associations.

The work of the British Cotton Industry Research Association on problems connected with spinning and weaving is described. Spinning tests for the Empire Cotton Growing Corporation are now carried out in the new laboratories under complete supervision throughout, each cotton being spun to more than one count, and an attempt being made to spin it to the limiting count suitable.

In connection with fabrics research the report states that "following on the completion of the examination of samples of fabrics exposed at Holton Heath, the research workers concerned in the investigation into the destruction of fabrics by micro-organisms are now engaged in preparing for consideration by the Committee a review of the results obtained from the exposure of fabrics at the above station and at the various stations abroad. Work has been continued at the Royal Aircraft Establishment on the development of a 'permanent' method of fireproofing fabrics, and encouraging results have been obtained. In the course of further work at the National Physical Laboratory on the action of sunlight on cellulose, strips of a cotton cloth have been impregnated with varying quantities of iron, and exposed to light so that some information may be obtained as to the order of iron concentration at which protection begins to be afforded. Exposures intended to explain some apparent anomalies in the effect of humidity on tendering by light have been continued during the year; a set of samples, including some practically free from wax, has also been prepared and exposed in sealed tubes in order to determine the origin of the carbon dioxide which has been found to be produced in such circumstances. A preliminary experiment has been concluded in which cotton was exposed to a dispersed spectrum from a mercury arc, and the changes occurring at different wavelengths examined; this showed that longer exposures were necessary, and the period has, therefore, been extended. This research will be brought to a conclusion in the near future."

256. Report and Proceedings of Conference of Colonial Directors of Agriculture. (*Colonial*, No. 67. Pubd. H.M. Stat. Off., 1931. Price 1s. 3d. net.) We have recently received a copy of this Report of the first Conference of Directors of Agriculture, called by the Secretary of State in July, 1931, to discuss questions bearing upon agricultural development in the Colonial Empire. The Conference discussed a number of subjects. Under the heading of "Training of Agricultural Officers" it is placed on record "that for future recruitments, post-graduate training in agriculture and in the sciences related thereto is of the highest importance, and should ordinarily be insisted upon." In connection with the training of officers for subordinate services, it is recorded "that the provision of regular training of local subordinates is necessary, and is one of the duties of a Department of Agriculture." Under Agricultural Education, the progress of the movement for giving a rural bias to elementary education throughout the Colonial Empire is noted with satisfaction. The work of the Imperial Agricultural Bureaux is appreciated. It is recommended that steps be taken to disseminate information in connection with the introduction of economic crops, and also in regard to their sources of supply; that local advisory bodies should be constituted where practicable; that produce inspection and grading should be enforced as much as possible; and that agricultural co-operation should be encouraged, etc.

257. REPORT OF COMMITTEE ON EDUCATION AND SUPPLY OF BIOLOGISTS. (Pubd. H.M. Stat. Off., 1932. Price 1s. net.) The report of a Committee of the Economic Advisory Council, appointed by the Prime Minister to consider the obstacles which stand in the way of the education and supply of biologists for work in this country and overseas, and to submit recommendations for the removal of such obstacles.

258. LIVERPOOL COTTON ASSOCIATION. By R. G. Wood. (*Trop. Agr.*, viii., **12**, 1931, p. 325.) Describes the work of the Association, which came into existence in 1882.

259. ROYAL SOCIETY OF ARTS COMPETITION OF INDUSTRIAL DESIGNS. Particulars of the Ninth Annual Open Competition of Industrial Designs, to be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, London, S.W. 7, in June, 1932, have now been issued, and can be obtained from the Secretary of the Royal Society of Arts, John Street, Adelphi, London, W.C. 2. Intending competitors must apply to the Secretary between May 2 and 9 for the necessary entry forms, the last day for receiving entries being May 21. The designs will be received at the Imperial College of Science and Technology between June 6 and 8. In all, Scholarships and Prizes amounting to some £1,400 are offered in connection with the 1932 Competition.

260. "COTTON FACTS," EDITION OF 1931. The 56th edition contains, as in former years, useful statistics of crops, receipts, stocks, exports, imports, visible supply, sales, prices, consumption, and manufacturing output of cotton and cotton products in the United States and other countries, also mill statistics of the U.S., Europe, India, etc., and acreage and yield statistics for each state and county in the South, and other matters.

261. TEXTILE RECORDER YEAR BOOK, 1932. Deals as usual with nearly every phase of textile manufacturing. All the statistical data have been revised, and many new figures added. Three new systems in connection with High Drafting are described, and a new section on Beam Dyeing is included. A bibliography of new textile inventions introduced to the trade during the past year is also included.

262. MEMORANDUM ON THE USE OF THE UNIVERSAL DECIMAL SYSTEM OF CLASSIFICATION. (Issued by Imp. Agr. Bureaux, 2, Queen Anne's Gate Bldg., S.W. 1.) An indispensable guide to all who are interested in library classification and filing of papers.

PERSONAL NOTES

We offer our warm congratulations to two of the Vice-Presidents of the Corporation, the Rt. Hon. Walter Runciman, M.P., and the Rt. Hon. W. G. Ormsby-Gore, M.P., on their appointment as Cabinet Ministers in the present Government. Mr. Runciman, as President of the Board of Trade, becomes President of the Board of Trustees of the Corporation. Our congratulations are also extended to Lord Stanley, a member of Council, on his appointment as Parliamentary Secretary to the Admiralty.

We offer our sincere and hearty congratulations to the Chairman of the Executive Committee, Sir Richard Jackson, whose public work in Lancashire, and whose services both on behalf of the Corporation and as a member of the Colonial Development Fund Committee, received recognition in the New Year's Honours List by the award of a Knighthood.

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes " home " on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

India	Dr. W. Burns.
Kenya Colony	Mr. P. Booth.
,,	Mr. H. N. Jones.
Nigeria	Mr. A. W. Anderson.
,,	Mr. D. H. Baker.
,,	Mr. G. W. G. Briggs.
,,	Mr. F. E. Buckley.
,,	Mr. T. Laycock.
,,	Mr. H. G. Poynter.
,,	Mr. G. N. K. Turnbull.
,,	Mr. H. B. Waters.
,,	Mr. W. A. Watson.
Sierra Leone	Mr. A. H. Kirby.
,,	Mr. E. Innes Nisbett.
Tanganyika	Mr. W. H. Potts.

The following officers of the Corporation's staff abroad will shortly be arriving in this country on leave:

South Africa	Mr. F. S. Parsons.
,,	Mr. D. MacDonald.
Southern Rhodesia	Mr. J. E. Peat.
Swaziland	Mr. J. V. Lochrie.

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THE IMPROVEMENT OF COTTON PRODUCTION

BY

ALBERT HOWARD, C.I.E., M.A.,

Late Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India and Rajputana (1924-31).

IV.—THE INTRODUCTION OF IMPROVEMENTS INTO GENERAL PRACTICE

THE experiment station phase is the first step in the development of cotton growing. Active measures must subsequently be taken to weld the improvements into the general rural economy. Until this is successfully accomplished, the results achieved at an experiment station remain mere counsels of perfection.

What guiding principles should be followed in this task? When the time came for considering this question at Indore, the fullest use was naturally made of the previous experience of other workers in this field. For twenty years a sustained effort had been in progress in India for developing the agriculture of the country, including the cultivation of raw cotton, and similar attempts had been made in other parts of the Empire. A copious literature dealing with these enterprises had for some time been in existence. The methods adopted for reaching the cultivator have recently been summarized and published by the Empire Marketing Board.* A critical examination of this work discloses two almost universal weaknesses which it is proposed briefly to discuss. In the first place, *effort has been diffused rather than concentrated*; in the second place, *insufficient attention has been paid to the human factor.*

Diffusion of effort is the chief weakness underlying most attempts to help the cultivator. A number of large and unwieldy schemes are set in motion rather than a few definite and well-defined projects. In most cases the results aimed at are out of relation to the means at the disposal of Agricultural Departments. In India, the cardinal mistake has been the creation of a large and expensive organization for dealing simultaneously with the whole of this enormous country, and this has led to a great deal of superficial work which is now beginning to bring discredit on the whole movement. Practically all the outstanding successes have been obtained in the few cases where more modest objectives have been envisaged. These examples point clearly to the need of a radical change in policy. Work will have to be much more thorough and concentrated on a few projects, which, moreover, will have to be taken up one at a time. All idea of a complete organization for dealing simultaneously with such an immense tract as the sub-continent of India will have to be abandoned.

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* *The Dissemination of Research Results among Agricultural Producers* (E.M.B. 33). H.M. Stationery Office, London, 1930.

The application of the principle of concentration will do much to increase the effectiveness of all schemes for the distribution of seed of improved varieties of cotton—the first step in placing the production of the raw product on a better basis. The weak point in most of the existing seed-distribution schemes is that they do not meet the requirements of the trade, namely, the rapid appearance of a large number of pressed bales of improved cotton in a group of neighbouring markets. From the merchant's point of view these bales are the outward and visible sign of any successful scheme of seed distribution: they create and maintain his active interest in cotton research, and the sooner, therefore, they are available the better. From the cotton grower's point of view a large quantity of improved produce is equally satisfactory. There will be sufficient cotton on the market to create competition among the dealers: the problem of an adequate premium for better quality will tend to settle itself. To bring about all these desirable results the first condition is the existence of a large amount of seed concentrated in a definite area, preferably in one which feeds a few adjoining cotton markets. The aim must be (1) to define the area in which it is proposed to replace the existing cottons, and then (2) to arrange for ample seed to effect complete replacement in two years at the outside. In this way all difficulties in the successful marketing of the new cotton can be overcome. A number of other desirable results will also be obtained. The danger of mixing the seed of the new cotton with inferior kinds in the ginneries will be greatly reduced, and natural crossing with local cottons will be almost impossible. It will be clear that an agricultural department or a large research institute cannot handle more than *one seed-distribution scheme at a time.* The whole of its energies and resources will, therefore, have to be concentrated on a single project. One outstanding success in a small area, however, will be much more effective than the same amount of effort thinly spread over a region the size of a Province of British India.

A successful scheme of seed distribution should be followed by the introduction of intensive methods of cotton growing, which is obviously much more difficult than mere distribution of seed. It involves in the first instance a careful study of the village community, the members of which collectively and individually must always be important factors in the project. In a country like India such a study must include a general survey of the village in order to ascertain whether any restrictions on enterprise exist on account of (1) the general framework of village society, (2) the system of land tenure, (3) the assessment and collection of land revenue, and (4) the movement and sale of agricultural produce. If, during such a study, any factors are discovered which discourage communal or individual initiative and enterprise, and prevent the grower from obtaining the full value of his produce, they must be removed, otherwise there will be insufficient incentive for the village as a whole to develop or for the separate cultivators to do their best. Such a survey of village conditions must also envisage the future; it will not be sufficient to remove present disabilities. The cultivator must be made to feel that he will always get a square deal. In other words, arrangements must be made so that the assessment of all future improvements, as between the cultivator and the State, is just to both sides. If all this is not done the introduction of intensive agriculture will never have a fair chance: little beyond the stage of a seed-distribution scheme or of a primary credit society will be possible: the results obtained at the experiment station will never affect the life of the people.

A serious effort is being made in the Indore State of Central India to prepare its 4,000 villages for an active programme of rural development based on the results obtained at the Institute of Plant Industry. On May 9, 1930, His Highness the Maharajah Yeshwant Rao Holkar, on his investiture with ruling powers, publicly announced that in the future the welfare of the agricultural classes would be his special care. This was coupled with an important practical step for implementing this new policy. The office of the hereditary village headman (*Patel*), whose position and functions for some time past had fallen into abeyance, was reinvested with fresh dignity and stability (1) by the grant of a substantial plot of revenue-free land (*watan*) as part of his remuneration, (2) by his recognition as an hereditary officer of the State, and (3) by the revival of the personal tie which binds him to the Maharajah. His Highness said: "I am ordering the grant of fifteen *bighas* of *kothi* land, free of assessment, to the *Patel* of every *khalsa* village, as a personal honour and a personal gift from me. The *Patels* will thus become *watandars* of my State; and I trust that they will be inspired by this mark of my personal favour ever to remain loyal to my house and to spare no effort to maintain and improve the prosperity of the villages entrusted to their care." In this way an active agent in the agricultural development work of the future was arranged for in each village of the State.

The improvement in the position of the village headman was followed by a detailed study of the villages themselves. For this purpose an experienced member of the Indian Civil Service, Mr. C. U. Wills, C.I.E., was invited by the Maharajah to assist him in codifying the law relating to the land revenue and land tenures of the Indore State. A new Land Revenue and Tenancy Act was prepared in 1930 which immediately became law. A feature of the new Act, which is a model of its kind, is the protection afforded to the cultivator. Suitable restrictions on the tenant's right of sale and right of mortgage, as well as on the problem of sub-letting, have been imposed not only in order to prevent the villager falling into the hands of the usurer, but also to conserve the effective State ownership of the land. A commentary on the new Act, which contains interesting chapters on the assessment of agricultural improvements as well as on rural administration, has recently been published.* The ground has thus been prepared for a bold and original policy of intensive rural development.

The next step was to bring the cultivators at suitable intervals to the central experiment station, so that they can see for themselves exactly what can be accomplished. For this purpose a permanent camp has been arranged alongside the Institute in which the men can be comfortably housed under actual village conditions during the period of their stay. The cultivators are shown exactly how they should proceed in transforming their existing extensive methods into an intensive system based on the eradication of permanent weeds, surface drainage and grading, the manufacture of compost from vegetable wastes, and the use of the Indore ridger for interculture. The preparation and use of silage is also included in the programme, as this item provides an effective reply to the invariable question about the provision of the additional cattle-power needed in intensive agriculture. The general programme is completed by detailed instruction in a number of improvements, such as the cultivation of ground-nuts as a rotation crop for cotton, the Java method of growing sugar-cane, simple improvements in sugar making, and the use of local oil-cakes as manure—all of which fit in with an intensive system of agriculture.

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* Wills, C. U., *The Land System of the Holkar State.* Oxford University Press. London, 1931.

The last stage in the introduction of intensive methods is the selection of a suitable area for development. In the case of the Indore State it has been suggested that a compact block of 50 to 100 villages within easy reach of the capital should be selected, and that work should be concentrated during the next few years on this tract only, leaving the rest of the State for the time being undisturbed. A sustained effort will be made to convert the whole of these village lands from extensive to intensive agriculture on the lines already described. A survey of the area will first be made so that a scientific system of surface drainage (combined with the realignment of the fields) can be installed, the surplus rainfall being collected in small reservoirs for maintaining the spring level of the wells and so assisting the development of well-irrigation. The eradication of permanent weeds, the grading of the surface, manuring by means of compost, as well as improved methods of interculture will then be taken up, together with the introduction of silage and the sowing of improved seed. At the same time such matters as communications, housing, and the general amenities of the village will be improved. The object aimed at is to provide the rest of the State with a striking example of what can be done during a period of five to ten years by the people themselves working under effective technical direction (provided by the State) and inspired by the personal interest of the Maharajah. The villages will supply the labour: the State will furnish the working plans and any expert assistance that is needed. Proceeding on these lines, an effective example of real development work is easily possible within the means of any Indian State or of any of the Divisions of British India. Once a few of these have been provided, the foundations of progress in the future will have been laid.

V.—THE TRAINING OF LABOUR

In connection with the introduction of improvements into general practice, the training of labour is a most important factor.* A contented and efficient body of labour must be recruited and maintained not only for the day-to-day work of the experiment station, but also to provide a labour pool from which selected men can be exported to the centres at which development work is in progress.

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* Howard, A., "An Experiment in the Management of Indian Labour," *International Labour Review*, Geneva, xxiii, 1931, p. 636.

When work began at Indore in 1925 great difficulties were experienced in obtaining an effective labour force. The Institute lies alongside the city of Indore, an important manufacturing and distributing centre with a population of over 127,000. Nine large cotton mills (with 177,430 spindles, 5,224 looms, an invested capital of Rs. 1,67,97,106, and utilizing 68,000 bales of cotton a year) find employment for 12,000 workers. In addition there are a number of ginning factories and cotton presses. The Institute therefore had to meet a good deal of local competition in building up its labour force. It was clearly useless attempting to recruit workers at rates below those readily obtained at the mills or in the city. Further, it soon became apparent that if the Institute was to succeed the Director would have to pay very careful attention to the labour question and to devise means by which an efficient body of men, women and children could be attracted and retained for reasonably long periods.

A consideration of this problem led to the conclusion that the first condition of success was to give the labour a square deal, to provide everybody with reasonable prospects of promotion by giving the work an educational value, to pay very strict attention to the regular and effective payment of wages, to limit hours of work to a reasonable length with regular and sufficient periods of rest, and lastly to furnish free medical attendance and medicaments.

The application of these principles soon met with success. In a very short time an adequate labour force was built up, partly from men recruited locally and from the Rajputana States, and partly from the wives and children of the Malwa Bhil Corps, the lines of which adjoin the Institute.

The precise manner in which the principles above mentioned have been carried out in practice are described below.

Payment of Labour.—Wage rates for the men on the permanent staff range from about Rs. 12 to Rs. 20 a month, while men on the temporary staff are paid 7 annas a day, women 5 annas, boys 3 to 6 annas, and girls 3 to 5 annas. After the rate of wages has been settled in each case, care is taken that (1) the payment of wages is made at regular intervals, and (2) the wages are paid into the hands of the workers themselves and there are no illicit deductions on the part of the men who disburse the money.

Regularity of payment is a matter of very great importance in dealing with Indian labour. At Indore workers on daily rates receive their wages twice a month—on the 3rd and on the 18th, in each case at 2.30 p.m. The permanent labour is paid monthly on the third working day of the following month. To ensure that all payments are actually made according to the attendance registers all disbursements are made in the presence of two responsible members of the staff. Both of these men have to sign a statutory declaration that the payments have actually been made. The signed statements come regularly before the Director for signature, and are in due course placed before the auditors. In making payments the envelope system is used, the payee making a thumb impression in ink in the register or signing his or her name. These arrangements have been found to prevent any illicit deductions on the part of the staff. The payments are made in public; the rate of everybody's pay is known; the signing of a proper declaration in the register makes it possible to institute criminal proceedings at once for any irregularity; the Director is always available for enquiring into any complaints. That none have ever been made proves that the labourers actually receive their pay in full at regular intervals. Payment is made in coin; no shops for the sale of food exist on the estate, and nothing whatever is done to influence the workers as to how they should spend their

Hours of Labour.—After the regular payment of wages, the hours of labour come next in importance. Indeed in India rest and wages are to a certain extent interchangeable, as the workers regard any extra rest as equivalent to an increase in pay. At first, the Institute observed the ten-hour day so common in India, but this was soon given up. It was found that during the hot months of April, May and June both the labour and the cattle required more protection from the hot sun, and an experiment was therefore made to reduce the hours of labour during the hot months to six daily, beginning work at sunrise and ending the day at sunset. The actual working hours of the three hot months were arranged in two shifts—four hours in the morning and two in the afternoon, with six hours' rest during the heat of the day—*i.e.*, from 10 a.m. to 4 p.m. At the same time the work was speeded up, and both labour and supervising staff were given to understand that the six-hour day in the hot months could only be enjoyed if everybody worked continuously and conscientiously.

The first result observed was a marked improvement in the health and well-being of the men and animals, probably due to the operation of two factors: the health-giving properties of the early morning air and the avoidance of excessive sunlight. With the improvement in general health there was a corresponding reduction in cases requiring medical assistance. To everyone's surprise, it was found possible to speed up the work considerably. The experiment of shortening the hours of labour was then extended to the rest of the year: working hours were reduced from ten to seven and a half.

These working periods, six hours in the hot weather and seven and a half during the rest of the year, refer to the time actually at work; an extra half-hour daily is spent in travelling to and from the place of work. In no case does the working period exceed seven and a half hours, except for about a week at the sowing time of the monsoon crops. During this period, both man and beast do not obtain much more than two hours off duty for food during the hours of daylight. A full ten-hour day at high pressure is then the rule, as all realize that the sowing of cotton and other crops is a race against time. As soon, however, as sowing is over, the workers enjoy an extra day's rest on full pay. *The sowing of the monsoon crops is the only agricultural operation in Central India for which anything more than a seven-and-a-half-hour day is necessary.*

For three years the agricultural operations of the Institute have been conducted on the short-hours system, and the result has been successful beyond all expectation. The miracle of speeding up Indian labour has been achieved, and shorter working hours have led not only to contentment, but also to an increased output of work. This result has only been obtained, however, by careful and detailed planning of the work to be done each day. The daily work programme is drawn up by the Assistant in charge of the farm during the previous afternoon and submitted to the Director as a matter of routine, so that at daybreak each day the Assistant knows at once what has to be done and no time is lost in deciding what tasks have to be performed. The taking of the attendance and the allocation of labour to the various tasks occupies less than five minutes, and in less than ten minutes after assembly the various gangs are at work in the fields. A great point is made of getting down to the job at once. Punctuality is now the rule, and it is becoming rare to have to deal with late arrivals.

While it is important to start work with the sun, it is equally important to allow the labourers to reach their homes by sundown, particularly during the rains, when snakes abound. Indian workers like to reach home in daylight—a point of great importance in obtaining their willing co-operation. Finally, it is very interesting to note that the policy of the square deal on the part of the Institute towards its labourers as regards hours was soon answered by a natural desire on the part of the workers to give the Institute a square deal. Less supervision became necessary; everybody soon realized that a reduction in hours can only be possible if real work is done.

Leave and Holidays.—The Institute is closed, except for work of extreme urgency, on Sundays and on twelve important festivals during the year. In addition to these 64 days, the permanent labourers are allowed one day's leave and one day's sick leave every month provided they work 25 full days during the month. In cases of injury while on duty, they are allowed full pay up to a maximum of 7 days. In the case of temporary labour, all holidays and leave, except the extra day allowed after the sowing of the monsoon crops, are given without pay.

Housing.—As regards living accommodation, the demands of Indian labour are very modest. A roof which does not leak during the rains, a dry earthen floor, a room that can be locked up, a partially closed-in verandah, which serves both as a kitchen and a storehouse for firewood, are all that is expected. At Indore, the one-room cottages are arranged in blocks of six round an open courtyard in which four trees have been planted to provide shade. The quarters are fumigated and whitewashed once a year, when any petty repairs to the roofs and brickwork are attended to.

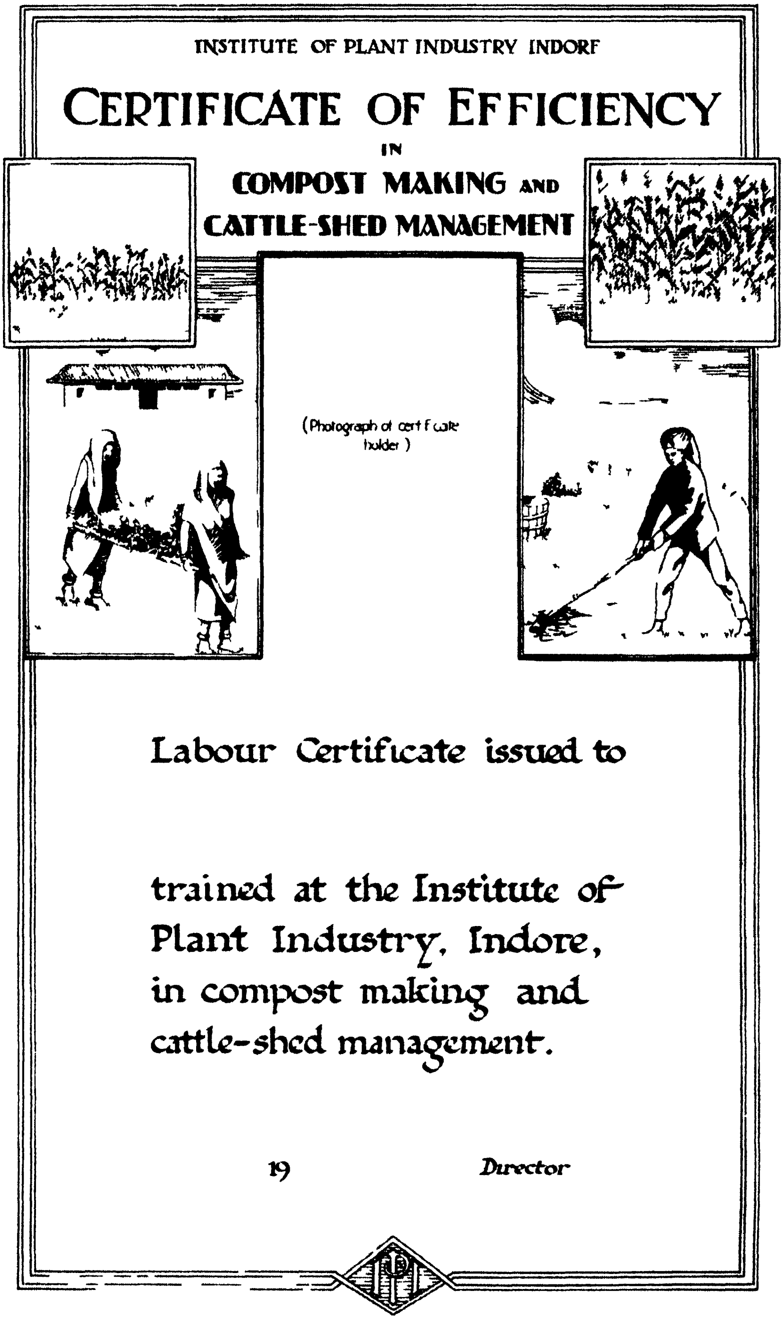
After a storm-proof room, the next essential is a supply of good drinking water and a separate well for washing. The water used for drinking is raised by a simple wheel pump; the well is provided with a masonry coping about two feet high; no drinking vessels are allowed to be dipped into the water. In this way the risk of cholera is greatly reduced. Once a simple wheel pump is installed, the labourers and their wives never attempt to lower a bucket by means of a rope.

Provident Fund.—So far no provident fund for the workers has been instituted. The Institute provident fund only applies to the permanent staff drawing Rs. 30 per month or more. Till the completest confidence between the workers and the management has been achieved, any suggestion of keeping back the pay of a labourer for a provident fund is likely to be misunderstood. It was decided to start a provident fund for the educated staff and gradually to extend its benefits to the labour force if and when a demand comes from the workers themselves.

Medical Arrangements.—The workers and staff employed at the Institute obtain free medical attendance, and in addition, the workers and the staff drawing less than Rs. 30 per month obtain free medicaments. The workers are examined weekly by the doctor, so that any precautionary treatment or any advice can be given in good time. In cases of childbirth the services of a nurse are provided free of charge. The personality of the Sub-Assistant Surgeon dealing with Indian labour is very important; the workers deal with an unpopular man in a very effective fashion—they never make use of his services.

Certificates of Efficiency and Promotion.—An experimental station, like any employer of labour, needs some system by which the labour force can automatically renew its youth. The annual export of trained labour to centres at which improvements are being taken up is one of the important functions of the Institute. For these reasons, therefore, a supply of promising recruits must be arranged, and to bring this about some system of promotion for proved efficiency had to be devised. At first this took the form of an annual promotion examination for the ploughmen. As they increased in efficiency and could manage and assemble their implements, and also plough a straight furrow, their pay was increased by Re. 1 per month. This system is now being superseded by the certificate plan. All the permanent workers in the Institute are eligible for special training, so that they can earn efficiency certificates for such operations as (1) cultivation, sowing, and care of the work cattle; (2) compost making; (3) improved irrigation methods; (4) the manufacture of sugar. A certificate of efficiency (with suitable illustrations) signed by the Director is awarded for proficiency in any of these items (Plate III.). Each certificate, which is awarded annually, will carry with it an increase of Re. 1 per month on the basic pay. When a member of the labour force has gained all four certificates, he will become eligible for transfer to other centres on higher pay. In this way the Institute holds out hope and places it within the power of any man to increase his starting pay in four years by about 30 per cent. It also enables an ambitious labourer to save enough money in a few years to purchase a holding and to become a cultivator. This is now taking place. Every year a few of the labourers return to their villages with their savings to take up a holding on their own account. Others are deputed for work in the contributing States on increased pay. The vacancies are automatically taken either by younger members of the same family or by volunteers on the waiting list of temporary workers.

A good deal of time, trouble and thought had to be expended on the labour question before all the problems involved were solved and before a really efficient labour force was built up. The final result, however, proved to be well worth while. During 1928 and succeeding years it is no exaggeration to say that each member of



INSTITUTE OF PLANT INDUSTRY INDORE

CERTIFICATE OF EFFICIENCY

IN

COMPOST MAKING AND

CATTLE-SHED MANAGEMENT

(Photograph of certificate holder)

Labour Certificate issued to

trained at the Institute of Plant Industry, Indore, in compost making and cattle-shed management.

19

Director

PLATE III.—CERTIFICATE OF EFFICIENCY FOR THE MAKING OF COMPOST

the labour force was worth at least two of the men with whom operations were started three years before. For work at new centres a supply of trained workers proved to be absolutely indispensable. Their superior physique, their obvious efficiency, and the way they set to work invariably had its effect on the local labour and enabled the workers sent out by the Institute to establish a natural leadership in the task in hand. Further, these men have served as an excellent advertisement of the new ideas advocated by the experiment station. In the heavy task of introducing intensive methods of agriculture in a group of 50 to 100 villages of the Indore State, a steady supply of trained workers will be invaluable.

The system of training labour described above was devised to meet a particular purpose, namely, the efficient conduct of experimental work at the Institute and the rapid introduction of the results in the villages of Central India and Rajputana. Nevertheless, the writer feels that a great deal of this experience is of universal validity. One of the great weaknesses in the production of almost all agricultural products at the present day is the low standard of work, a result partly due to the poor quality of rural labour.* One of the future tasks before the agricultural colleges and experiment stations is to prove to all concerned how important it is to train the workers and to make them really efficient. In a very short time the lesson that one really well-trained worker is worth more than any two ordinary labourers will spread to the locality round about. In due course one of the great obstacles in the proper organization of agriculture, namely, an inefficient and poorly paid labour force, will slowly disappear. As this reform takes place, a higher standard of agriculture will be reached, which in turn will be followed by higher standards of living, and the rural population will then begin to absorb increasing amounts of the things produced in factories, including cotton cloth.

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* Duncan, J. F., A new policy for agricultural labour, *Internat. Labour Review*, Geneva, xxv, 1932, p. 165.

COTTON IN NYASALAND

BY

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THE intention in writing this article is to supplement, and bring up to date, the account given in this journal in 1929 (see " Cotton in Nyasaland," Vol. VI., No. 4). Since the above-mentioned article was written changes have occurred which promise greatly to modify the cotton-growing industry of Nyasaland.

In the first place the decision has been taken to link up the northern and southern sections of the Nyasaland railways by a bridge over the Zambesi. Work on this bridge and its approaches was started in 1930 and is now well advanced, and it is hoped that traffic over it may commence in 1935-36. It has been further decided to extend the railway northwards from Blantyre, the present terminus, not as was originally suggested to a port on the Old Livingstonia peninsula, but to Domira Bay in the Dowa district, some forty miles up the Lake on the western side. The importance of this second decision can hardly be exaggerated, since it means that, instead of coming to a dead end, the northern extension has been surveyed to a point which gives a ready means of access to the rich hinterland of the Central Angoniland province. The distance from Fort Jameson in North-Eastern Rhodesia to railhead will be halved.

Provision is also being made for the improvement of the steamer service on Lake Nyasa, and when all is completed, the whole of the present and potential cotton areas of the Nyasaland section of the Great Rift valley will be placed within easy reach of main-line communication with the coast at Beira.

The outstanding problem to be considered, however, is what the freight rates on cotton will be when the new services are opened. Up till now, as was explained in the previous article, Nyasaland and its railways have suffered from various difficulties, which have made the handling of really large quantities of produce practically impossible. The physical difficulties are now in the course of removal, and it remains to be seen if sufficient encouragement will be given to the production of relatively low-priced crops—and cotton must now be considered one of these--by a policy of reasonably low rates.

Only a considerable increase in the amount of produce carried can pay for the cost of the new works now in progress, and make low rates an economic business.

In commercial cotton growing the three seasons which have passed since the previous article was written have produced two features of particular interest.

As was explained previously, European production had practically given way to the native grower in 1929. The results for the three seasons are as follows:

In Bales of 400 Lbs.

	European.	*Native.*	*Totals.*
1929	133	5,888	6,095
1930	178	9,153	9,331
1931	45	4,161	4,205

It will be seen from the above that the native production has not only retained its importance, but in 1930 exceeded the previous record of 8,600 bales in 1917, when there was little but European estate grown cotton.

The drop in production in 1931 reflects not only the effects of a thoroughly bad seasonal rainfall distribution, but also the effects of the world slump in cotton prices. That lower prices paid the natives is not the most important feature to be considered is shown by the fact that seed issues for 1932 are much in excess of estimates, and that the crop, in the Lower Shire areas, is now expected to be but little short of that of 1931. This in spite of the fact that, with the lapse of the British Cotton Growing Association buying agreement last August, there is no guarantee of prices, and that a restricted area has been planted. It would appear that cotton is now firmly established as a native grown crop, and that the British Cotton Growing Association agreement has served its purpose. Owing to the expectation of low prices Government decided to restrict 1932 seed issues, which are now entirely in the hands of the Agricultural Department, to the Lower Shire and Central Shire areas within easy distance of the present railway. It is of note that natives of the Lake shore areas are disappointed at not being allowed to grow cotton this year, in spite of the low prices paid last season. This augurs well for the future, when it is hoped that the railway extension will make the reopening of the Lake areas possible even for "sixpenny" cotton.

There is little doubt that cotton appeals to the native as a crop which he can grow with but little personal trouble.

Work on the Experiment Stations, and on observation plots in various parts of the country, has made considerable headway.

It has been decided that the whole of the Rift valley areas shall be considered as one cotton zone, in which a range of conditions, mainly due to soil variations, enables cotton to be grown either as a summer or as a winter crop. Intermediate types of crop, which are neither strictly summer nor winter, can also be grown, especially in areas of deep soil when the seasonal rainfall is good and well distributed. In general, it has been found that the nearer to the true winter crop one can approach, the better the pests are "dodged," but the more specialized the conditions required. Some form of natural subsoil irrigation must occur for a winter crop, sown, say, in late March, to be a real success. Areas as far apart as Port Herald, Domira Bay, and Karonga have all been found to provide suitable conditions.

From the point of view of acreage, the summer or semi-summer crop areas of the Rift valley are the most important, and it has therefore been decided to concentrate work on these. In this connection it is very fortunate that the improvements in the transport arrangements of the country make it possible for Domira Bay to be chosen as the main station. Its geographical position alone is much in its favour, and with the current ideas about the similarity of the problems throughout the Rift valley areas the intermediate nature of its conditions is an attractive feature.

It has been found that the ecology of the Domira Bay area varies according to soil type from plant associations very similar to those found on the Palombe plain near Makwapala to associations very like those of the Lower River areas served by Port Herald. This would indicate that there is little risk to be anticipated in breeding cottons at this station for general distribution.

Cotton strain tests, particularly with U.4 from Barberton—a cotton which is proving suitable for a very wide range of Nyasaland conditions—will be carried out from 1932-33 onwards with seed grown at Domira Bay.

Work at Makwapala and on plots in the Lilongwe area has confirmed the two plateau areas of the country as suited only to summer crop cotton. An exception is a small area on the Palombe plain where soil conditions allow a semi-summer crop. The rest of the Palombe plain—especially where soils approximate to the lateritic loam of Makwapala—and the balance of the cotton areas of the Shire

Highlands, are essentially summer crop areas which must be sown as early as the rains allow.

The Central Angoniland plateau, where in the Lilongwe area plots have been grown for observation the past three years, has proved to be the most extreme area in which cotton has yet been tried in Nyasaland. Frosts in June-July appear a definite limiting factor, and growth is much slower than is usual elsewhere in the country. Only very early cottons are likely to succeed in this area. The results at Lilongwe are rather surprising, since the elevation is much the same as that of the Gatooma Station in Southern Rhodesia, and the ecology of the area similar to that seen in the Gatooma district; it is, however, farther north by five hundred miles or so, and yet appears to be far more extreme in its temperatures. It is the first area in Nyasaland where cotton has been tried and temperature found to be a real limiting factor. Selections for earliness have been made in the plots grown at Lilongwe last season, and these have been replanted in a low-lying area believed to be a frost hollow. They will be re-selected this season. The Lilongwe area is readily accessible from Domira Bay.

The classification of the cotton areas of Nyasaland given on page 196 is, it will be understood, somewhat generalized, since the demarcation of the administrative districts does not necessarily correspond to the natural demarcation of the country by physiographical and ecological features. Certain districts are, however, divided into eastern and western sections by the fact that the Rift valley runs north and south. For example, Dowa E. is part of the Lake shore section of the Rift valley and Dowa W. part of the Angoniland plateau.

Districts 1 and 2 form the Lower River section of the Rift valley, and are the main cotton-producing areas at present. The climate in these districts for most of the year favours the cotton rather than its pests.

Districts and part-districts 3-10 comprise the balance of the Rift valley areas in Nyasaland where cotton has been or can be grown. Conditions as a whole are slightly less favourable to cotton than in the Lower River, though there is little to choose between the best Lake shore areas in Dowa and Kotakota and this area.

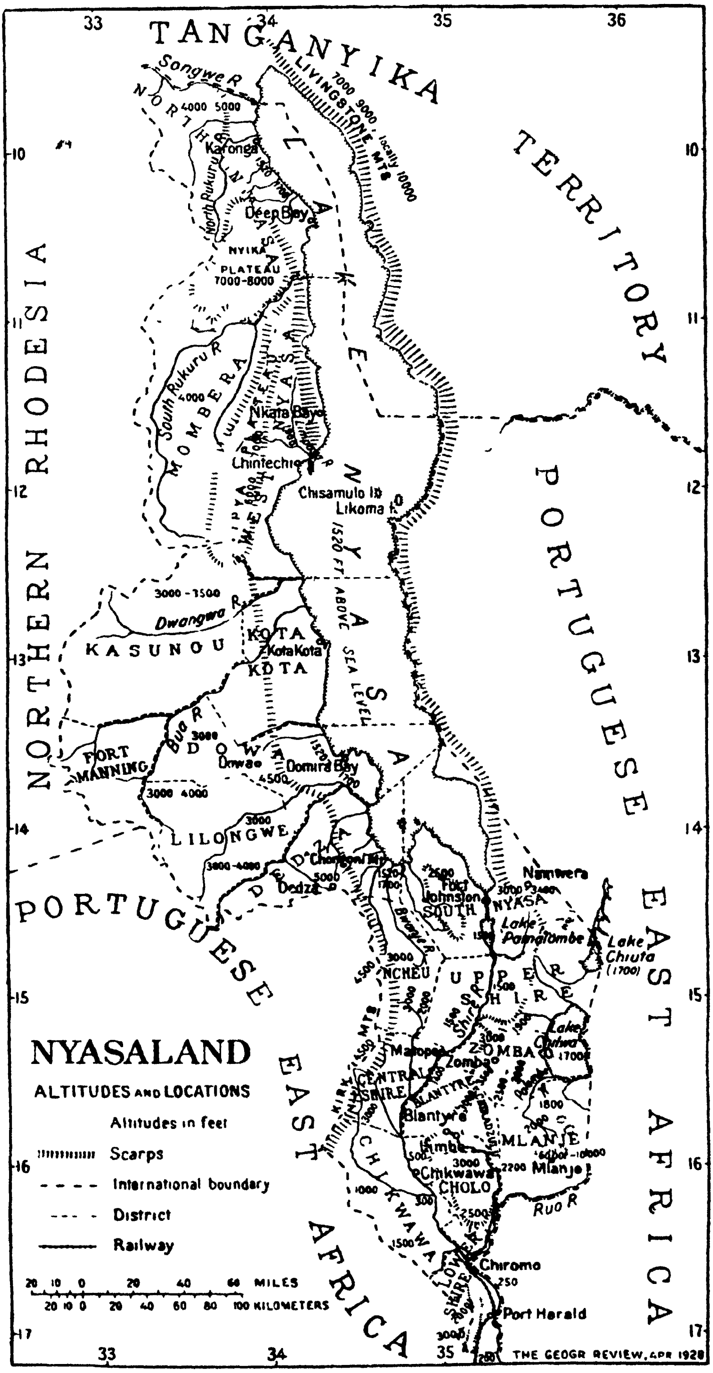
The third group of districts forms the eastern plateau areas, and the fourth the western plateau, comprising Central Angoniland. Conditions for cotton growing in these areas are distinctly less favourable than those of the Rift valley groups, since if the rains are not suitable, the crop, except in the specialized and restricted area of the

Palombe plain in the Zomba district, where later planting may succeed, will be unable to fruit before cold or drought limits development.

As mentioned above, results obtained on the stations and on observation plots elsewhere have indicated that in the mixed bulk U.4, selected by Mr. Parnell at Barberton, a cotton has been found which gives fair to good results over the whole of the Nyasaland areas. This flexibility is unapproached by any cotton previously tried, and is of such importance commercially that in 1930 it was decided to use the isolated Lisungwe area in Blantyre W. district for immediate large-scale bulking of this strain. In spite of an unfavourable season, and the upset to marketing due to the world slump in cotton prices, sufficient seed was obtained from this area to supply some two-thirds of the entire 1932 acreage.

District.	*Approximate Elevations above Sea Level (Ft.).*	*Types of Crop.*	*Months in which Sown.*	*Months in which Harvested.*
1. Lower Shire	200–500	Winter Semi-summer	Mar.–May Jan.–Feb.	Sep.–Dec. July–Oct.
2. Chikwawa				
3. Blantyre W.	1,000–2,500	Winter Semi-summer Summer	Mar.–May Jan.–Feb. Nov.–Dec.	Sep.–Dec. July–Oct. May–Aug.
4. Upper Shire W. ..				
5. S. Nyasa W.				
6. Ncheu				
7. Dedza E.				
8. Dowa E.				
9. Kotakota E. ..				
10. Karonga E.				
11. Cholo	2,000–3,500	Semi-summer Summer	Jan.–Feb. Nov.–Dec.	July–Oct. May–Aug.
12. Mlanje				
13. Blantyre E.				
14. Chiradzulu				
15. Zomba				
16. Upper Shire E. ..				
17. S. Nyasa E.				
18. Dedza W.	2,500–4,000	Summer	Nov.–Dec.	May–Aug.
19. Lilongwe				
20. Ft. Manning				
21. Dowa W.				
22. Kotakota W. ..				
23. Kasungu				

The Lisungwe area has again been supplied with U.4 seed, mainly from the stations, and a second wave thus started to help sweep the cotton areas clear of all but U.4 stock. In 1933 Lisungwe will for



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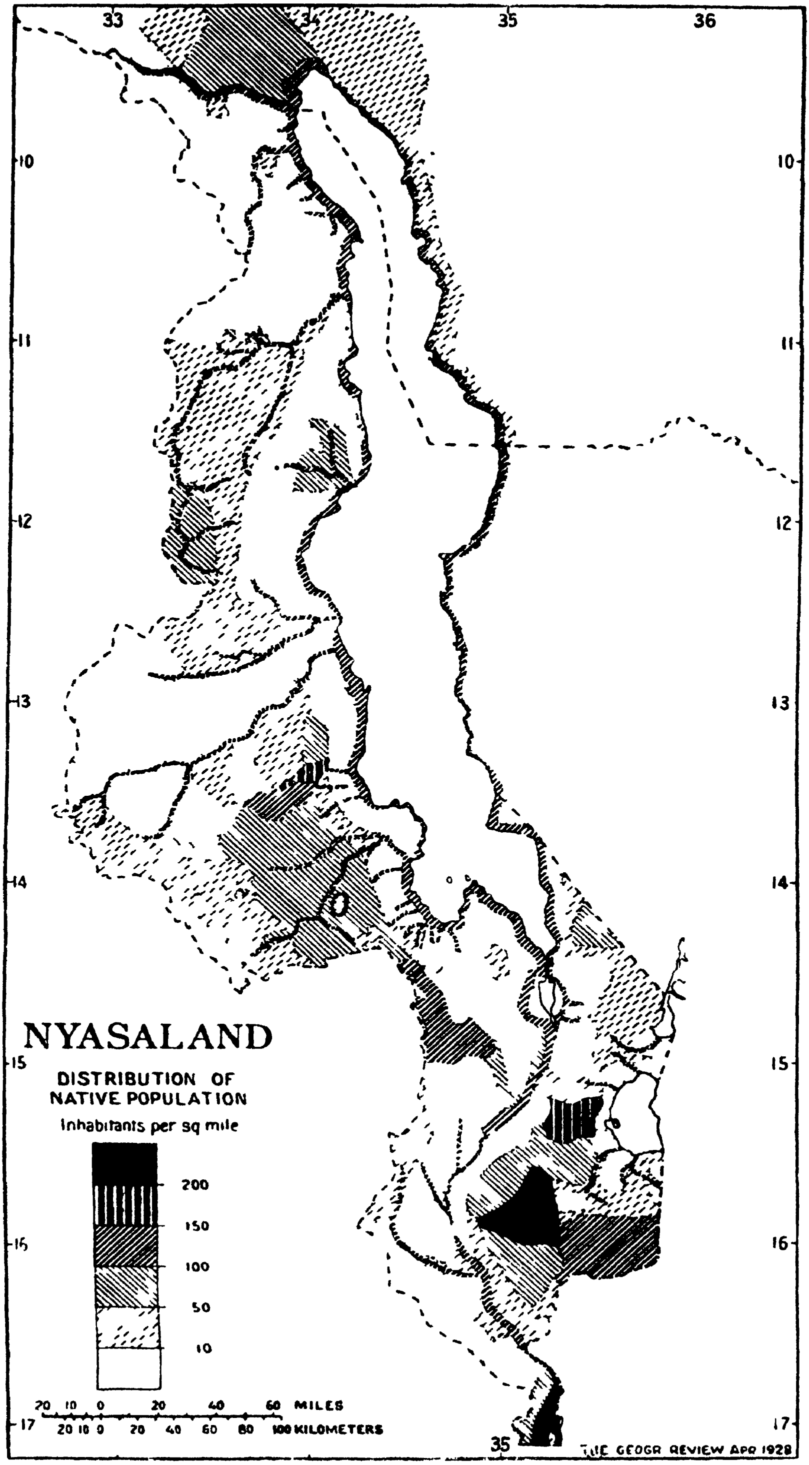
NYASALAND
DISTRIBUTION OF NATIVE POPULATION
Inhabitants per sq mile
200
150
100
50
10
20 10 0 20 40 60 MILES
20 10 0 20 40 60 80 100 KILOMETERS
33
34
35
36
10
11
12
13
14
15
16
17
35
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the third time be supplied with mixed bulk U.4 seed grown by the experiment stations, and in 1934-35 the whole country should be supplied with a reasonably pure stock.

In this work both the Government and the Corporation have been greatly assisted by the co-operation of the British Cotton Growing Association, who have arranged separate ginning facilities for the Lisungwe seed cotton at their Port Herald ginnery.

The earlier and presumably contaminated stocks of mixed bulk U.4 will be destroyed as new stocks from the experiment stations, bulked first at Lisungwe and then in the Port Herald area, are available to take their place.

The complete scheme is as follows:

1930–31.
Mixed bulk of U.4 from Stations and elsewhere to Lisungwe.
1931–32.
Mixed bulk of U.4 from Stations to Lisungwe. Seed from Lisungwe 1930–31 crop to Port Herald-Chiromo section of Lower River area.
1932–33.
Mixed bulk of U.4 from Stations to Lisungwe. Seed from Lisungwe 1931–32 crop to Port Herald. Port Herald crop from 1931–32 crop to general issue.
1933–34 onwards as for 1932–33 until such time as it is decided to replace the mixed bulk U.4.

The mixed bulk, admirable as it is, needs improvement in various respects, and a good start has been made with sub-strains which it is hoped may yield a stock superior to the parent bulk. The main features desired are uniformity and a rather better staple. The only adverse criticism of the commercial samples sent home last year was that the U.4 lint lacked fineness. Otherwise it was as good as, or better than, the usual Nyasaland Upland.

In addition to straight selection attempts are being made to incorporate in the U.4 stock by cross-breeding some of the good points of other cottons which have shown promise under Nyasaland conditions. This work is being done at Domira Bay, where it is hoped that two generations may be produced annually in suitable breeding plots.

In spite of the present world slump and all it implies it is difficult to be otherwise than optimistic about cotton growing in Nyasaland.

Though the size of the country is against it becoming a producer on the Uganda scale, it has considerable advantages over many countries in its native population, soils, and climate, and should maintain, and augment in the near future, its reputation as a producer of a good class of American type cotton.

By 1936 the worst of the physical obstacles to the development of Nyasaland cotton growing—poor communications—should be a problem of the past. From then on it will be largely a matter of pounds, shillings, and pence.

Received May, 1932.

THE COTTON BREEDING STATION, GATOOMA, SOUTHERN RHODESIA

BY

J. E. PEAT.

THE Cotton Breeding Station at Gatooma combines cotton breeding and general cotton research, and functions as a cotton seed farm. It extends at the present time to 643 acres, of which 500 acres—forming part of the Gatooma commonage—are leased from the Southern Rhodesia Government for a nominal rent; the other 143 acres, adjoining the commonage, being leased from a private holder. Some 320 acres are now under the plough; the remainder comprises paddocks, shelter belts, roads, and the area set aside for houses, laboratory and farm buildings. The whole Station is fenced along the boundaries, internal fencing enclosing the paddocks and the plantations. It is financed and equipped entirely by the Southern Rhodesia Government, which also provides two assistants and all native labour. The control and the direction of the Station are solely in the hands of the staff of the Empire Cotton Growing Corporation. This arrangement has worked very satisfactorily, and it is a pleasure to have this opportunity of acknowledging the continued support of the Southern Rhodesia Government, and the very real interest which it has always taken in the cotton work proceeding at Gatooma.

The altitude of the Station is approximately 3,770 feet above sea level. The soil is variable, the greater part being a red loam, derived from the underlying greenstone formation. An area adjoining the eastern boundary is felsitic. Only portions of the land under the plough are used for the cotton work, certain lands, owing to patchiness and to soil irregularities, not being suitable for accurate cotton experiments and strain comparisons. A total acreage of sixty to seventy acres is now under cotton each year, working in a rotation on the more suitable lands available to this crop. Experience has shown that it is important not to confine the cotton work, in any one year, to one section of the Station only. There is each year as much replication as possible of the trials, single plant lots and selections, introducing soil differences, and, generally, differences of previous treatment. One section, if necessary, is planted slightly later than the other, and usually some distance from it. In addition to the duplicate arrangement of trials, etc., additional comparisons of the more promising strains are available in bulks and strips. It has been found that the sections of trials and single plant lots are subjected to different degrees of bollworm, jassid, and aphis attack. This double or multiple record of behaviour each year is of great value where one strain or selection may happen to be on a poorer patch of land than its fellows with which comparisons are desired, or where one section of trials or strains may be subjected to an exceptionally heavy bollworm, jassid, or aphis attack.

Maize is the main rotation crop grown, and a proportion of the acreage each year is under a green manure crop—at present mainly sunn hemp. Groundnuts, sunflowers, beans are also grown, and miscellaneous other rotation crops on a small scale.

Experience is being gained in the actual management of the Station soils. Reference has been made in the annual reports to the poor results following a bare fallow. Certain treatments of the soil are found to produce a better growth and fruiting than others. Probably over a number of years there is an approximate carbon/nitrogen ratio for optimum growth and fruiting. The addition of humus to the Station soils is definitely necessary, and the ploughing in of green manure crops has been adopted. At the present time sunn hemp is chiefly used, but in a year of good growing conditions there seems to be a greater liability to aphis and jassid attack on the cotton following a sunn hemp crop ploughed in. It is thought that the ploughing in of dolichos beans or sunflowers may produce a better style of growth in the following cotton crop, and this is being tried; or possibly it might be advisable to take off a maize crop before planting cotton. The direct fertilizing of cotton in the normal way—the surface application of the ordinary fertilizers at the time of planting—does not produce much response, and growers are being advised, therefore, not to fertilize cotton direct, but to fertilize the green manure crop with raw rock phosphates, or to fertilize directly crops known to respond to direct fertilizing. The effects on cotton, grown on land the second and third year after a fertilizer has been applied, are being observed. It takes several years with differing climatic conditions to obtain this information, and when obtained such information for the Station is only a starting point for outside experiment, and for advice to growers in other areas.

When the Station was started in October, 1925, some eighty acres were already under the plough, having been broken up the previous year, and a portion planted to miscellaneous crops as part of a Municipal Experiment Station; the remainder was virgin bush land. A further forty acres were stumped, cleared, broken up, and planted to cotton in November. There were no buildings. As the rains were starting, unburnt bricks were quickly made and a plant breeder's house, a temporary laboratory building, seed store, and implement shed were put up. The necessary implements were bought, and the work of the Station might be said to have commenced. These temporary, unburnt brick buildings erected by the Station staff, served their purpose, but it was impossible to keep them in repair, in addition to which the accommodation and facilities were quite insufficient; and they have now been replaced.

There are at the present time two plant breeders' houses, a foreman's house, a combined field office, implement shed and store, and a small ginnery equipped with a 50-saw gin. A splendid new laboratory block of six rooms, with a large seed store attached, has just been completed. Tenders have been called for for a power plant for the Station, and for a distribution system. Light and power are to be supplied to the laboratory block and to the houses, and power will be available for pumping and ginning. Only the laboratory block and one house have been erected by the Government Public Works Department; the other buildings have been put up by the Station staff.

In the first two seasons, 1925-26 and 1926-27, the land was raw and crops were poor, but the effects of jassid attack were shown up, and something was learned of the meaning of jassid resistance. The Cambodia cottons, with their hairiness, stood up in a most striking manner against jassid, for although late maturing, and unsatisfactory from other points of view, they produced something in the nature of a crop, whereas the range of American varieties being grown all succumbed, in a greater or less degree, to the pest.

In the 1927-28 season 10 lbs. of Parnell's U.4 seed were obtained from Barberton, and this was planted out at wide spacing for multiplication purposes. The crop was very satisfactory for the type of season experienced, there being a total yield of over 3,000 lbs. of seed cotton from the 10 lbs. of seed planted. The crop was rogued for jassid resistance, a special bulk was taken out, and a large number of selections were made. U.4 was issued to selected growers for wide-spaced multiplication in 1928-29, and was under commercial cultivation in 1929-30.

Since 1928-29 the Station has made considerable progress. In that season the U.4 selections were planted out in single plant lots; fertilizer, spacing, and other agricultural experiments were commenced, and with a fairly satisfactory jassid resistant stock the selection and experimental work was able to proceed.

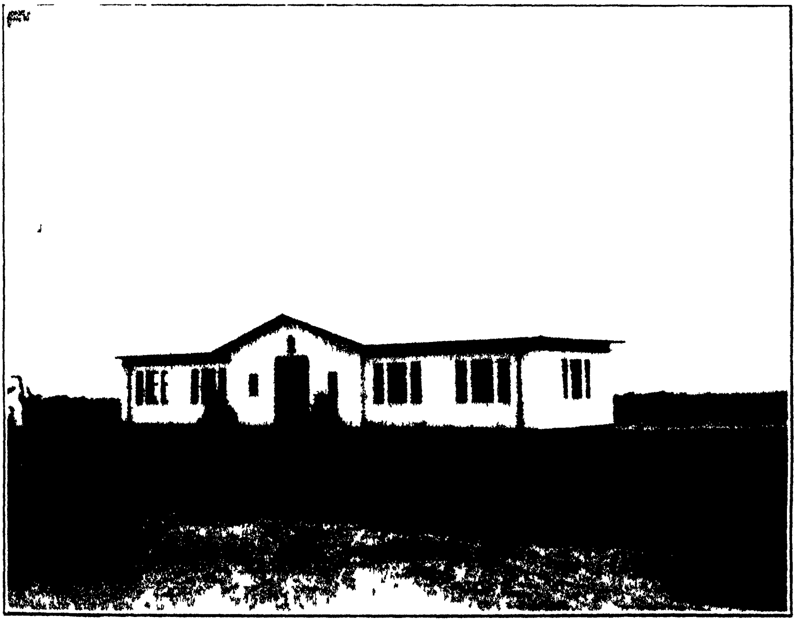
A large range of quite dissimilar, single-plant types showed up in the original bulk U.4, ranging from a slender, delicate type, such as Parnell's U.4/4 to completely different, vigorous, fleshy, leafy types, such as /114, possessing, to a varying extent, the qualities required. On multiplication, however, it is not an easy matter to get a true idea of the relative values of these single plant lots. Their behaviour, to a certain extent, varies from year to year under differing conditions; and conclusions may be reached after two or three dry years which may be upset in following seasons of fairly heavy rainfall, heavy jassid or heavy bollworm attack. The experience of growth on a fairly wide range of soils and conditions throughout the country and for several years is needed before strains can be issued, with safety, for commercial growing. In order that it may be issued with confidence as an improvement on the commercial bulk U.4, a strain must be able to do well in a normal year, but in addition, it must be able to stand up to a wet year or a year of heavy jassid attack; it must have a certain power of recovery in a year of bollworm attack; and in a dry year yield moderately, and produce lint of at least fair quality.

Naturally, results are sometimes discouraging. A large number of strains, which have promised well at first, have shown up faults in subsequent years, and have had to be discarded. Some very satisfactory material is now being bred up on the Station. Strains are under multiplication, and a certain amount of seed has been issued to growers. Single-plant lots are being grown under observation, and are being tested, and further reselections are made each year from the better material. A constant process of selection and elimination is taking place.

As with the Bulk U.4, so to a lesser extent some of the original selection bulks such as /64 are segregating; a proportion of less productive types is showing up and there is a certain segregation for jassid resistance. A fair knowledge has been gained of the weaknesses of these strains, and improvements have been made by further selection. Thus, from the beginning there is demonstrated the necessity for continued breeding work—rogueing in the original selected bulks and in the single plant lots, with continued breeding from reselections.

The most important part of the breeding material at Gatooma is derived from three original families, /64, /78 and /106, strains from which have been tested now for a number of years both on the Station

The Plant Breeder's House, Gatooma



The Research Laboratories

and in the districts, under quite a range of conditions—dry years and moderately wet years, years of little and of much jassid, and of heavy or light bollworm attack. There are two or three outstanding strains from each of these families, one or more of which will be issued for next season. At the Station careful trials are laid down each year to compare the newer strains, and single-plant lots, with the older families. A selection on multiplication may not necessarily be an improvement on the bulk from which it came, though it may have appeared so on first selection.

A fair degree of jassid resistance is the first requisite for any strain for Rhodesia; without fairly good resistance, there is no hope of satisfactory crops over a range of years, and it is necessary that, in multiplication, this resistance be maintained. At Gatooma two or three dry seasons of low jassid infestation made it difficult to do much in the way of elimination of less resistant strains and further selection for resistance. In the present season, 1931-32, however, on one part of the station, following a sunn hemp crop ploughed in, there is a complete range of trials, half-drill strip comparisons, single-plant lots, and selections. Rains have been continuous during February and March, and there has been, and still is, the heaviest jassid attack experienced since U.4 has been grown on the Station. It is now possible, in a satisfactory manner, to eliminate for jassid susceptibility, to rogue the better bulks and lots, and to select within the single-plant lots for greater jassid resistance. Such a season as the present is, therefore, of very distinct value. On the duplicate section of trials, single-plant lots, and selections, at the other end of the Station, the jassid attack is more moderate, and the differences between the strains as regards jassid susceptibility are much more difficult to discover.

It is probable that from the plant material on the Station strains of sufficient resistance for ordinary commercial conditions could be obtained, but a season such as the present shows that there are few of the strains being grown whose powers of resistance could not be improved by rogueing and selection.

The qualities of the lint produced from different strains vary within limits from year to year, under differing climatic and soil conditions. It is important that these qualities be studied in wet and in dry years, and over a fairly wide range of conditions. Especially important in Southern Rhodesia are the strength and character of the lint. There are strains which give excellent lint when grown under normally good conditions, but which tend to produce soft lint, without character, under droughty or bad conditions. It is important that the strains being bred up and issued should produce lint of at least a fair quality in difficult years. These qualities seem to be affected by the temperatures when the crop is maturing, as well as by the moisture and food supply available to the plant.

The lint length of the most promising strains being bred up varies around a commercial 1⅛ inches. The continuance of the breeding work will ensure greater uniformity of staple and a general improvement in quality, especially under extreme conditions. Continued selection and line-breeding is necessary to fix the qualities being obtained, and already quite distinct segregation can be seen in some bulks from the first selected strains. There are also differences in ginning percentage which must be considered in strain comparisons. Members of the /64 family, for example, have, for U.4, a relatively low ginning percentage.

The most serious field obstacle to fully successful cotton-growing in Southern Rhodesia at the present day is the injury caused by bollworm. There is the possibility of American bollworm attacks in broods from February to April inclusive. These attacks vary from light to severe, a severe attack causing a heavy loss of buds, flowers, and young bolls, but less damage to the formed bolls. It has been found that early maturity—the setting of a crop of bolls relatively early in the season—is an important factor in the production of a commercial crop in spite of bollworm damage. At the other end of the season, the power of recovery after an attack is important.

Experiments have been going on, since bulk U.4 was available, to find out the optimum field spacing. Fairly close spacing, around 3 feet 6 inches between rows and about 6 inches between plants in the row, or slightly wider, is considered the most satisfactory, and the increased yields of the closer over the wider spacings have been very marked in years of American bollworm damage. The closer spacings set a relatively heavier, early crop, which is often partly formed before the appearance of the first American brood. This early production of a crop is important, even in normal years, in a country such as Southern Rhodesia, but especially so in a season of American bollworm damage. Even in this, a relatively wet season, the closer spacing seems to be yielding the best results. These experiments are being continued throughout the country.

During the last two seasons the Station has also suffered from attacks of Sudan bollworm, and there have been similar attacks, varying in degree, throughout the country. While not, so far, as serious as American, Sudan bollworm causes a fair degree of damage.

Early maturity does not help much with an attack of this pest, which tends to feed in the larger, more matured bolls. With a prolific strain, however, a fair attack may be experienced and yet a good commercial crop be left for harvesting. A very important quality to be considered is the type of response of the strain after the attack. Strains of good type respond quickly with further fruiting instead of heavy vegetative growth.

In addition to the above, there is the Spiny bollworm, which, however, appears to be more of a minor pest. It is present each year, but does not cause injury comparable with that of American or Sudan bollworm.

The problems caused by the attacks of these three types of bollworm are receiving much attention, and influence considerably the breeding, cultural and field work. The breeding of strains more suited to the conditions of the country, and improved cultural practices, such as closer spacing, are helping in the production of commercial crops in spite of bollworm attacks. It is found that the nature of the attack, and the proportions of the three bollworms present, vary in any year from district to district, and the intensity of attack even from field to field on the one farm. One field may be quite heavily attacked, while fields nearby suffer much less. Experiments have been carried out on the dusting of crops with calcium arsenate to control the American broods; trap crops have also been used, and investigations have been made on the parasitic control of bollworms and bollworm eggs.

Stainers are other pests which in some years assume considerable importance; the methods used for stainer trapping and the results achieved are described in the annual reports. Here also breeding work may influence the problem. Certain strains are leafy, vigorous, and vegetative, while others are open, with relatively little leaf. The difference in the amount of shade provided for stainers is considered important. In years of bad stainer attack it will be wise to pick more often, especially where the seed is required for planting.

Compared with the loss caused by insect attack, that caused by fungoid and bacterial diseases is of very much less importance. Probably the most important diseases are Internal Boll Rot (insect-borne) and the External Boll Rot (Bacterial Boll Rot and Alternaria).

As has already been mentioned, the investigations being carried out at the Station at Gatooma, to be of full value, must be supported by evidence from other districts. In a country of the area of Southern Rhodesia there are, in certain years, considerable variations in conditions between districts, particularly variations in rainfall and insect attack. It is most important that records of behaviour for the country be obtained from crops grown on different types of soil and subjected to differing climatic conditions; also records of the seasonal development of the crop, the loss which has taken place, the crop which has resulted, the type of growth, the qualities of the crop under the conditions prevailing, the bollworm attack; then, as an extension of the investigations of the Station, a comparison of the more important strains under these conditions, and the efficiency or otherwise of pest control measures and cultural practices.

The start that has been made with outstation recording work, strain, spacing, and fertilizer comparisons has been described in the Station reports (cf. Abs. 286).

A new cotton-growing area such as Southern Rhodesia must to a large extent work out its own salvation. Only within limits can it rely on the results of investigations in other, and apparently similar, regions. While making use of the general experience gained by workers in other lands, it is necessary to investigate each problem for the country. Few of the results of these other workers will be directly applicable to the new conditions, and very few of the strains that they have bred up will be at all happy in the new environment. Progress with the type of work proceeding at Gatooma is not definite and straightforward, like the erection of a building or bridge, or the development of a known mine; rather might one describe it as indeterminate. The conclusions of one year have to be modified, and frequently altered, in the light of the experience of succeeding years, and there must be much discarding of material which at first promised well. Progress in the issue of strains, and the recommendation of practices, must not be too fast. For some time it will probably be wise to steer more of a middle course, that results may be satisfactory under normal conditions, and yet, that there be the least liability to complete failure under extremes. The fruits of the experimental work centred at Gatooma—the joint enterprise of the Government of Southern Rhodesia and the Empire Cotton Growing Corporation—will be the improved quality and increased yield of the commercial cotton crops of the country, through the greater knowledge of the crop obtained from the experiments and investigations carried out during several years.

Received May, 1932.

THE SCHEMERS

BY

R. R. ANSON,
Cotton Specialist, Fiji.

"Yes, I shall have my hands pretty full, but I think it will be worth it; at any rate, there can be no harm in trying."

"No, I suppose there is no harm in trying, but do you think you will make anything of these Fijian natives? They are just like a lot of irresponsible children, and will never stick at anything for long. How do you propose to run the scheme?"

The two cotton officers having finished dinner were sitting out on the veranda, each sipping occasionally at a cold whisky and soda, which he balanced on the arm of his lazyboy chair. The conversation had drifted around to "shop," as it invariably did after dinner when they were together. They were discussing the prospects of an agricultural training scheme for Fijians which the former had recently taken over.

After what seemed a fairly long pause the first man spoke again. "Well, I don't know; to my mind the natives have never been given a real chance to show what they are made of. The present system of governing them is undoubtedly an excellent system, but it savours too much of communism, which, in my view, must kill all individuality and ambition. There is no point in being ambitious if a man has to share out all his hard-earned gains with his neighbour who has, perhaps, done nothing, and this, as you know, has been the custom with most Fijians. I want, if possible, to hold their interest by competition, and by this means we may be able to work them up to a certain amount of enthusiasm. I certainly think that if once we can make a success of one centre, the thing will go ahead like a house on fire and there will be no holding it, and providing that one gets sufficient backing from Suva, there seems to me to be no reason why the show should not become a really big one. We have thousands of acres of excellent land at our disposal, which are simply crying out to be worked. Last year the Government purchased a number of light implements which they issued to several towns, with the proviso that they be paid for from the proceeds of the cotton crop. Without any set policy, this would be rather difficult to enforce, because, instead of delivering their seed-cotton by towns, it was brought in by numerous individuals, and it would have made no end of work figuring it all out at the ginnery. Anyhow, the hurricane which we had in February depleted the cotton crop to such an extent that, had we enforced this system, there would have been very little left for the natives.

"I propose to confiscate all implements which have not been paid for by the end of the year, give them a serial number, and re-issue them to four main centres, place a trained Fijian in charge of each, and make each centre commence a balanced crop rotation consisting of money, food, and green manurial crops.

"You will remember how keen all the chiefs and headmen appeared at the meeting which was held at the Cotton Station. They made most flowery speeches, saying how grateful they were to the Government for offering them this wonderful opportunity, etc;. but all the time I felt quite certain they were saying to each other: 'Look out, brother, there is a catch in this somewhere!' The part which interested them most was the feast."

"Tell me about it."

"Very well; it will take some time, but here goes. We provided two bullocks, a sack of rice and five pounds of yagona, and left the local natives to do the rest, which, believe me, was no mean portion. There were crowds and crowds of women all dressed up in their best sulus of brilliant-coloured silks. Each wore a garland of flowers, and each troupe had their hair dyed in a different way, some white with lime, others bright yellow with hibiscus pollen. They marched in single file into the temporary shelter which had been made from palm leaves, every woman carrying a basket, also made from plaited palm leaves, and each basket was brimful of food. There were yams, dalau, cassava roots, kai (a shell-fish), bread-fruit, etc. They placed their burdens in the centre of the structure, and bending very low, as is their custom when in the company of high chiefs, they crept out again. By the time the last woman had placed her contribution on the pile, it was about three feet high and at least seven feet in diameter. This having been completed and the 'tabua' (whale's tooth) having been presented to the District Commissioner, the natives all sat solemnly and waited in silent respect. Presently the native aide-de-camp to the District Commissioner got on to his feet, and walking very reverently over to the heap he touched it with both hands, and then sitting down with his legs crossed in tailor fashion, he looked from one side of the enclosure to the other, then, cupping his hands, he clapped them together. After a short pause he made a very flowery speech, apologizing for the smallness of the heap for so auspicious an occasion, and then raising his voice an octave or so he finished in a sort of chant, the remaining natives joining in and finally ending up with intermittent clapping of their cupped hands. The guests then sent their representative forward, and going through much the same procedure, he harangued us at length upon the enormous and sumptuous repast which we had so generously provided, etc. His speech ended in exactly the same manner. The meeting was then over, and the chiefs were taken and shown over the Station. The poor fellows tried to appear interested, but I am afraid their thoughts were mostly dwelling on the feast of 'pulumakau' (bullock) which awaited them in the new hut. Finally they got down to the feast, and I showered them with cigarettes."

"And were you able to commence your scheme soon after the meeting?"

"Rather not; I had three more before anything was done. I'll tell you about them. Ratu Aesaya Vasatoga, the native Roko, thinking that something ought to be done, called a meeting and ordered all the young men and landowners to attend. The meeting-place was well over forty miles from here, and accompanied by my assistants I rode up hill and down dale, crossing and recrossing the river at least ten or eleven times, to find only four men there, all headmen—a complete washout—not a single young man! I gave the headmen three hours in which to collect men wishing to work on the scheme. They managed to collect about six, but, seeing that they were not a scrap in sympathy with it, I told Vasatoga there would be no meeting, and that if this district really did eventually wish to commence a scheme, it would be the last to receive our consideration. I *was* wild. Vasatoga then called all the headmen and men together and, with his tongue in his cheek, he gave them a half-hearted ticking off, and we departed to our house for some dinner. When dinner was over Vasatoga crept in and apologized for having brought us out on a wild-goose chase; he said he was anxious to commence an agricultural scheme, but apparently his men were not. I found out afterwards that a feast had been held at a neighbouring town in memory of a chief who had died a year before. We could therefore not have chosen a more inopportune time for calling a meeting.

"Some weeks after this another abortive meeting was held at Qalamari which cost us a bullock. It was certainly very much better attended than the former, but no decisions could be arrived at concerning land tenure.

"I was beginning to feel that nothing could come of the scheme, and that all that I had heard about Fijians was perfectly correct. It seemed to me waste of time trying to do anything with them, and they must be a lazy lot of good-for-nothing washouts.

"About the middle of October, however, a note came from my friend Ratu Vasatoga, asking me whether I would be able to attend a large feast which was to be held at Bemana, in order to discuss further the agricultural scheme. I felt very sceptical about it, but decided to go. It was a thirty-mile ride, and having started fairly late, I was obliged to push on at a good pace in order to arrive in time for the opening. At each village which I passed through I noticed that preparations had been made to receive me, but on finding that I did not turn up, the youth of the villages had hurried on up to Bemana.

"On reaching Bemana I was awfully surprised to see a very large gathering; natives had ridden from near and far, and masses of horses were tethered on the outskirts of Bemana town. My Assistant, Ratu Vasatoga, and the headmen of the town came out to meet me. I was travel-stained and filthy, quite unprepared for such a formal gathering, so I hurried into a private house, washed, changed, and came out just as the ceremony had commenced. This time I was the guest of honour and was offered a lazyboy-chair, while my Assistant and a French priest from the neighbouring Mission Station sat one on either side of me, and Vasatoga squatted tailor fashion on the floor near by.

"The place was packed with men. Half naked bodies, thoroughly greased with coconut oil, blackened faces, and hair decorated with hibiscus flowers, seemed to fill every inch of it. All eyes were on me as I approached, and when I had taken my seat, they all chanted a song which sounded for all the world like the baying of a pack of bloodhounds, and sent a creepy feeling down my back. Yagona was prepared in ceremonial fashion, and this being completed I was offered a 'bilu' (a cup made of a coconut cut in halves and polished) by a burly warrior with blackened face and clothed in beaten-out bark of the vou tree. While I drank, the crowd of natives chanted a weird but rhythmic song, and when I had drained the cup they shouted 'Embu' (throw it). I threw it spinning on the floor, whereupon the entire assembly shouted 'Maca' (it is empty!).

"The yagona having been served to every one, I made a speech which was put into the vernacular by Vasatoga. A return speech was made by the Buli Bemana, but I understood hardly a word. Then the assembly declared the yagona bowl empty, and filed out of the house and we were left alone. Presently a native girl came in, dragged out a table from an inner room, and after having covered it with a sheet, proceeded to set it with knives, forks, and spoons. The headman appeared and informed us that he had prepared dinner for us 'vakavavalagi' (in English fashion). The dinner duly arrived, beautifully cooked: chicken-broth, prawns cooked in coconut milk, baked chicken, baked potatoes, yams and dalou netana, followed by tinned peaches with grated coconut.

"When dinner was finished the headman reappeared and told us that the children had made ready a little entertainment for us. It was fairly dark outside and the Fijian band had taken up its position all squatting on the ground. The band consisted of a wooden drum, ukelele, and a dozen or more male and female singers, and at one side a huge fire was burning. Three chairs were arranged for us about twenty paces away from the band, and when we had taken our seats in these the elders and chiefs arranged themselves around us. Suddenly a small figure, naked except for a reed girdle, sprang up from amidst the band, then several more came from the bush, and others from behind the huts, until in all they numbered about four dozen. They darted towards the fire, each seizing a fire-stick of burning bamboo; then they fell into line and commenced a sword-dance with the fire-sticks, and all the time they gradually worked nearer and nearer to our chairs until, as they became more and more visible, we were able to see that each one had his face and legs (as far as the knee) painted a ghastly white. Suddenly they wheeled and charged us, halting with a shriek only a few paces away. Then, making a good imitation of the Charleston, they retired backwards, their white legs accentuating the shivery-shaky motion of the Charleston and Shimmy Shake combined, which looked most effective. Backwards they went until, their torches having been extinguished, they were eventually enveloped by the darkness. There was then a few minutes' interval, during which the natives chatted together. Presently a troupe of women appeared garlanded with coloured raffia and with split banana leaves tied around their waists over coloured sulus; some carried spears, others clubs, and others fans; in all they numbered about three dozen. Those with the spears formed up on the right, the clubs in the middle, and the fans on the left. Then the band struck up, and keeping in splendid time with it, our entertainers gave us an old-time war dance. This was followed by a dance given by the very old women, and it was well past midnight before we turned in.

"Next morning a meeting of the young men and landowners was held. There must have been well over one hundred of them present. I could see at once that the general feeling was very different from that with which I had been met upon the two former occasions. Enthusiasm ran high, and all seemed eager to make a start. Practically the whole of Colo West was represented; the native mind was beginning to grasp the scheme and to perceive its possibilities; the elders had become less suspicious, and landowners offered their land to the scheme on very generous terms. It was to be given rent-free until it came under crop, and then a charge of three shillings per acre would be made after the first crop was harvested. Fourteen young and able-bodied men, most of whom owned either bullocks or horses, offered their services. Within a week ploughs were brought up to this centre, land was marked out and cleared, and ploughing-lessons commenced. The natives from other districts watched with interest, and in no time we had our four centres under way; but let me point out here and now that were it not for the energetic and untiring work put in by my Assistant, I doubt very much whether we should have got the scheme started. He has put his whole heart into it and worked on it day and night."

"This is all quite interesting, but how are you going to market your crops, and how do you propose to expand without capital?"

"Well, as to the marketing of the crops, the cotton we sell to the ginnery, we have a buyer for as much rice as we can produce, potatoes we can sell locally, tomatoes and peanuts we hope to export to New Zealand. I know we have no capital except that which was originally advanced for the purchase of implements. Each centre will have to buy in its implements from crop proceeds, and this money will be used for purchasing more implements. We hope to sell our surplus food crops in local markets—a shed is to be erected at Vunasalu for this purpose and another at Lautoka."

"You have certainly bitten off a large mouthful, but I think, with you, that you have laid the foundation-stone of a scheme which, if properly fostered, should make good agriculturists of the Fijians; but forgive me if I say you are in for many a setback before this is achieved. Well, old man, I think it's bedtime."

"Yes, let's have a nightcap."

A PRELIMINARY NOTE ON THE SAND-SOWING OF COTTON SEEDS

BY

J. TEMPLETON, D.Sc.

GENERAL

WITHIN the last few years great attention has been given at the Experimental Station at Giza to the early stages of growth of the cotton plant, it having been realized that so far as methods of cultivation are concerned this is the most important stage in the plant's growth. The first picking is known to be largely determined during the first ten weeks of growth, so that the greater the care given to the plants during this time the greater will be the yield obtained from the first picking.

To make the point quite clear, we have only to consider the maturation period of the flower, the boll, and the time of the first picking. At Giza the latter takes place on the average about August 25. From the laying down of the primordium of the bud till the day the flower opens is at least forty-two days, and from then till the boll opens is on the average fifty days. If we work backwards from August 25 therefore, it is clear that a boll which opens on that day came from a flower whose primordium was being laid down about ninety days previously, or on May 27. All bolls picked on August 25 therefore had their origin in flower buds laid down between the sowing-date (March 15) and May 27, a period of approximately ten weeks. Since the first flower at Giza does not open till the first week in June it is interesting to observe that the first picking is largely determined actually before the plants start to flower.

It is not suggested that little or no attention need be given to the plants after May 27, but it is definitely held that up till then is the most critical period in the plant's growth, and all that can be done during that period to maintain the plants in a healthy and robust condition, and so ensure their holding their flower buds, will have its reward in increased first pickings. In further support of this contention it should be remembered that the majority of the shedding which takes place is of small flower buds of about 2 mm. in diameter, and these are very readily shed in the early stages of growth should the plants receive a check in growth due to water shortage or to any other cause.

Investigations showed, for example, that the general practice of leaving the seedlings without water for from six to eight weeks was deleterious to yield through the shedding of the early buds. Cutting down the period between the first (sowing) and second watering to three weeks resulted in increased yields being obtained* by enabling the plants to retain more of their early flower buds. This was well illustrated in the flowering curves.

It seemed scarcely possible that even the method of sowing would have an appreciable effect on the yield, but such has been found to be the case—and to a remarkable degree. It is the main purpose of this note to draw attention to this.

SAND-SOWING

In 1925 Balls† described a method of sowing cotton seeds (sand-sowing) whereby the maximum number of plants could be obtained from a given number of seeds. This, of course, is invaluable in propagation work. During the last few years the method has been developed, under his direction, by a member of the staff of the Botanical Section, and is fully described in a Bulletin published by this Ministry.‡

The method essentially consists in the use of a special dibble for making a hole of a definite depth for the seeds, which are then covered with sand or fine soil. Only 2 to 5 seeds per hole are necessary for a perfect stand as opposed to the usual 16 to 20, which represents a considerable saving in seed, a saving which at least pays for the slightly greater labour involved. Originally the method was used only for propagation work, but results recently obtained indicate that it would be decidedly profitable for ordinary field crops.

In a chequer plot experiment carried out at Giza in 1931 the factors involved were the sowing date and times of watering. In order to be sure of a good stand, particularly for the early sowings, half of each series of plots were sand-sown (5 seeds per hole) and half were sown in the ordinary way (16 to 20 seeds per hole). The yields of the plots are given below in kantars per feddan:

	Sand-Sowing.	*Normal Sowing.*
Early sown, early watered	8·31	7·26
Early sown, late watered	8·05	6·70
Late sown, early watered	6·42	5·02
Late sown, late watered	5·89	4·12

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* Templeton, J.: "Watering and Spacing Experiments with Egyptian Cotton." Ministry of Agriculture, Egypt, Technical Bulletin No. 112, 1931.

† W. L. Balls: "The Best Field Method for Sowing Cotton." EMPIRE COTTON GROWING REVIEW, Vol. II, No. 3, July, 1925.

‡ Gadallah Eff. Abul Ela: "Sand Sowing in Cotton Breeding." Ministry of Agriculture, Egypt, Technical Bulletin No. 80, 1929.

The main object of the experiment and the results will be dealt with elsewhere. Here it is desired only to show the quite unexpected result of the actual method of sowing.

The sand-sown plots in every case gave a very striking increase in yield compared with those sown in the ordinary way, the increase varying from a minimum of 1 to a maximum of 1·8 kantars per feddan.

If this quite phenomenal result is confirmed in this year's experiments the method of sand-sowing should certainly be employed throughout this country at least.

As to why sand-sowing should have given such increased yields the following explanations may be advanced.

With ordinary sowing 16 to 20 seedling plants per hole are left for about six weeks before thinning to the normal two per hole, as opposed to 5 in the case of sand-sowing. There would, therefore, be greater competition for nutrient solutions in the former case with less robust seedlings as a consequence. In addition to this, greater damage will be done to the root systems of the two remaining seedlings during thinning in the former case than in the latter, so that the inevitable check to growth due to thinning must be greater.

Experiments on the sand-sowing method, its effects on yield and how the effect is produced are being repeated and extended this year, and the results are awaited here with considerable interest.

Received April, 1932.

COTTON STATISTICS

INDIA

BY

JOHN A. TODD, M.A., B.L.

LAST year, in dealing with the season's history of the Indian crop, we referred to the consistently disappointing yield of the crop in recent years. As will be seen from Table I., the figures for the current season have carried that tendency still further. The acreage for 1931-32 is even smaller than last year, which makes it the smallest since 1923, while the crop shows a further heavy drop and is the smallest since 1920. The average yield per acre is also the smallest since 1920, being only 69 lbs. against the previous ten years' average of 88·7 lbs.

Two points require to be noted here, however. Each year the final figures of the previous year are revised, and the result of that revision last year was to raise the figure considerably. The second point is that the figures above referred to are those of the Government estimates, and for the last three years, as will be seen from Table II., the commercial crop has been very heavily in excess of the Government estimates, so that as a matter of fact the commercial crop of 1929-30 is the largest crop on record, being just short of seven million bales, and the 1930-31 crop was nearly as big. This chronic discrepancy between the two sets of figures is very unfortunate.

A good deal of light is thrown by the details in Tables III. and IV. on the causes of this year's small crop. Attention has been very widely drawn to the failure of the Oomras crop, which has resulted in the absurd position of Indian futures in Liverpool (which are based on Oomras) being actually higher than American futures. This failure has been pretty widely distributed over the whole of the Oomras belt, but is most striking in the Central Provinces, where the average yield is only 38 lbs. against 125 lbs. last year; and it is from this district that the best of the Oomras crop comes. The Bengal Sind crop, especially from the United Provinces, and the Punjab Sind crop have also suffered pretty badly.

In consequence of this the proportion of the total crop which is under ⅞-inch staple has suffered most severely, with the result that the proportion of $\frac{7}{8}$-inch and above makes a much better showing than it has done for a good many years. In this, however, unfortunately the Punjab-American crop has not shared fully, the yield there being the lowest since 1928. Apparently, therefore, it is the northern provinces which have suffered most, and this is borne out by the details by Provinces given in Table IV.

The shortage of the Indian crop is, of course, very much to be regretted from the point of view of the development of Empire cotton as a whole, but from the world point of view it has been almost an advantage. Since the War it has frequently been noted that whenever the American crop is big the Indian crop has, almost providentially, been small. This happened markedly in 1920 and 1926, and a repetition of the same curious accident was certainly providential for American in 1931. In recent years the consumption of Indian cotton has been gaining rapidly at the expense of American, but this year, as the result of the change in relative prices, the pendulum has swung the other way and Oriental countries, especially China and Japan, have been taking enormous quantities of American cotton. But for this the statistical position of American cotton would have been a great deal worse than it is. The following table of the exports of American cotton to the East for the last three years is very significant.

August to March.	1929-30.	1930-31.	1931-32
Japan .	870,485	966,079	2,060,216
China .	188,028	289,935	942,763
British India	6,998	74,790	215,087
Total ..	1,065,511	1,330,804	3,218,066

These things, however, have a tendency to right themselves very quickly. India has now had a fairly long succession of bad years, according to the Government estimates, and the luck ought to turn. Further, the opening of the Sukkur Barrage will in the long run add very substantially—at least 500,000 acres it is said—to the area under cotton in Sind, and as the yield under irrigation is relatively high, this ought to make a considerable difference in the Indian crop, especially as most of the area will be available for long staple cotton like the irrigated districts in the Punjab.

The table of the other Empire crops which follows the Indian tables is compiled by the Empire Cotton Growing Corporation.

TABLE I.—INDIAN CROP, AREA, YIELD, AND PRICE, 1914–1931.

Seasons.	*Area (Acres).* 000's.	*Crop (Bales of 400 Lbs.).* 000s.	*Yield per Acre. (Lbs.)*	*Net Exports and Consumption.* 000's.	*Season's Average Prices.*	
					No. 1 Fine Oomra.	*Per Cent. on American.*
1914–15 ..	24,595	5,209	85	4,889	4·46	85
1915–16 ..	17,746	3,738	84	5,109	6·09	81
1916–17 ..	21,745	4,489	83	4,985	10·32	84
1917–18 ..	25,188	4,000	64	4,499	18·78	87
1918–19 ..	20,997	3,972	76	3,991	18·13	92
1919–20 ..	23,352	5,796	99	5,343	19·23	76
1920–21 ..	21,340	3,600	67	4,941	9·20	77
1921–22 ..	18,451	4,485	97	5,972	9·60	85
1922–23 ..	21,804	5,073	93	6,270	11·14	75
1923–24 ..	23,631	5,161	87	5,946	13·35	74
1924–25 ..	26,801	6,088	91	6,923	11·95	87
1925–26 ..	28,403	6,215	88	6,508	8·97	83
1926–27 ..	24,822	5,024	81	5,624	7·18	88
1927–28 ..	24,761	5,963	96	5,661	9·21	83
1928–29 ..	27,053	5,782	85	6,675	8·03	76
1929-30 ..	25,922	5,243	81	6.991	6·39	70
1930–31 ..	23,812	5,224	88	6,750	4·02	70
1931-32 ..	23,522	4,064	69	—	—	—

TABLE II.—INDIAN "COMMERCIAL" CROP.

(RUNNING BALES 000's.)

Seasons.	*Net Exports.*	*Mill Consumption.*	*Domestic Consumption.*	*Total.*	*Discrepancy from Government Estimate Per Cent.*
1914-15 ..	2,118	1,771	1,000	4,889	- 6·2
1915-16 ..	2,486	1,873	750	5,109	+36·8
1916-17 ..	2,081	2,154	750	4,985	+11·0
1917-18 ..	1,705	2,044	750	4,499	+12·5
1918-19 ..	1,238	2,003	750	3,991	+ 0·5
1919-20 ..	2,680	1,913	750	5,343	- 7·8
1920-21 ..	2,113	2,078	750	4,941	+37·2
1921-22 ..	3,063	2,159	750	5,972	+33·2
1922-23 ..	3,411	2,109	750	6,270	+23·6
1923-24 ..	3,350	1,846	750	5,946*	+15·2
1924-25 ..	3,998	2,175	750	6,923	+13·7
1925-26 ..	3,775	1,983	750	6,508	+ 4·7
1926-27 ..	2,830	2,044	750	5,624	+11·9
1927-28 ..	3,140	1,771	750	5,661	- 5·1
1928-29 ..	3,933	1,992	750	6,675	+15·4
1929-30 ..	3,868	2,373	750	6,991	+33·3
1930-31 ..	3,729	2,271	750	6,750	+29·2

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* Up till 1923-24 the imports were deducted, because some of the mills in the Native States included foreign cotton in their consumption.

TABLE III.—INDIAN COTTON CROP: AREA, CROP, AND YIELD PER ACRE *BY VARIETIES.*

Varieties.	1928–29.			1929–30.			1930–31.			1931–32.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
I. *Mainly under ⅞ Inch Staple*												
Oomra (Khandeish, Central India, Berar, and Central Provinces) .	8,420	2,031	96	8.569	1.801	84	7.864	1,726	84	7,544	853	45
Dhollera	3,094	402	52	2,807	509	73	2,583	559	87	2,106	577	110
Bengal Sind (United Provinces, Rajputana, Sind, Punjab, etc) .	3,586	1,020	114	3,604	977	108	3,360	989	118	3,323	785	94
Comilla, Burma, etc.	460	93	81	467	104	89	517	123	95	359	67	75
Coconada	236	46	78	259	45	69	199	32	64	198	34	69
Total under ⅞ inch staple ..	15,796	3.592	91	15,706	3,436	88	14.523	3.429	94	13,530	2.316	68
Per cent. of total crop	58·4	62·1	—	60·6	65·5	—	61·0	65·6	—	57·5	57·0	—
II. *Mainly ⅞ Inch Staple and Above*												
Punjab (American)	974	189	78	806	248	123	837	269	129	763	217	114
Sind (American)	29	6	83	27	8	119	65	20	123	59	14	95
Broach	1,270	210	66	1,324	284	86	1,232	277	90	1,237	280	91
Coompta Dharwar	1,945	303	62	1,746	284	65	1.356	178	53	1,569	249	63
Western and Northern	1,835	349	76	1,551	172	44	1.540	182	47	1,874	221	47
Tinnevelly	610	162	106	601	162	108	525	129	98	548	140	102
Salem	224	42	75	221	38	69	200	36	72	199	36	72
Cambodia	384	147	153	395	144	146	248	90	145	283	121	171
Barsi and Nagar	3,986	782	78	2.629	341	52	2.315	488	84	2,598	355	55
Hyderabad Gaorani .. .				916	126	55	971	126	52	862	115	53
Total ⅞ inch staple and above ..	11,257	2,190	78	10.216	1,807	71	9.289	1,795	77	9,992	1,748	70
Per cent. of total crop	41·6	37·9	—	39·4	34·5	—	39·0	34·4	—	42·5	43·0	—
Grand total	27,053	5,782	85	25,922	5,243	81	23,812	5,224	88	23,522	4,064	69

000's omitted throughout in area and crop figures.

TABLE IV.—INDIAN COTTON CROP: AREA, CROP, AND YIELD PER ACRE *BY PROVINCES.*

	1927–28.			1928–29.			1929–30.			1930–31.			1931–32.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.)*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
Madras	2,123	447	84	2,495	528	85	2,507	513	82	2,071	381	74	2,255	428	76
Mysore	81	25	123	76	23	121	69	9	52	72	10	56	83	9	43
Hyderabad	3,631	951	105	4,019	895	89	3,536	447	51	3 527	651	74	3,644	509	56
Bombay*	7,765	1,802	93	8,048	1,447	72	7,297	1,309	72	6.299	1,278	81	6,218	1,302	84
Baroda	806	124	62	793	69	35	771	127	66	731	140	77	693	136	78
Central Provinces and Berar	4,796	1,235	103	5,078	1,334	105	5,175	1,252	97	4,750	1,136	96	4,588	484	42
Central India ..	1,263	234	74	1.287	252	78	1,388	211	61	1.284	214	67	1,187	128	43
Gwalior	585	115	79	645	107	66	633	89	56	619	103	67	632	76	48
Bengal	78	20	103	79	18	91	78	21	108	77	19	99	75	17	91
Bihar and Orissa ..	77	14	73	78	14	72	69	13	75	69	14	81	68	14	82
United Provinces ..	643	199	124	715	255	143	929	289	124	845	322	152	786	218	111
Rajputana	422	97	92	476	123	103	507	67	53	520	73	56	436	61	56
Ajmer Merwara ..	42	14	133	44	21	191	34	11	129	31	11	142	27	11	163
Punjab	2,068	602	117	2,841	619	87	2,536	799	126	2,490	767	123	2.547	618	97
North-West Frontier..	10	2	73	17	4	94	17	4	94	13	3	92	18	4	89
Assam	45	15	133	44	17	155	41	15	146	41	15	146	37	15	162
Burma	326	67	82	318	56	70	335	67	80	373	87	93	228	34	60
Total	24,761	5,963	96	27,053	5,782	85	25,922	5,243	81	23,812	5,224	88	23,522	4,064	69

* Including Native States, also Sind and Delhi. 000's omitted throughout in area and crop figures.

EMPIRE COTTON CROPS FOR THE YEARS 1921–31, EXCLUDING INDIA.

(*In bales of 400 lbs.*)

The seasons are given as covering two years (*e.g.*, 1926–1927) because in the majority of the countries named **planting takes place in one calendar year and picking** in the next. In a few of these countries, however (*e.g.*, Tanganyika, Iraq, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the ***latter*** of the two years at the head of the column.

COUNTRY.	1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.	
(1) Anglo-Egyptian Sudan	30,519	24,074	28,306	47,652	44,912	121,131	148,118	126,115	161,536	157,769	120,310	(1)
(2) Gold Coast ..	61	49	15	93	1,132	1,218	285	264	296	200	297	(2)
(3) Nigeria ..	30,000	15,096	16,811	25,694	39,137	47,909	27,464	20,930	32,126	43.925	18,850	(3)
(4) Uganda ..	81,365	48,290	88,046	128,604	196,038	180,859	131,728	138,486	204,057	129.969	191,305	(4)
(5) Kenya ..	500	417	1,200	1,653	2,250	2,046	1,232	1,241	1,984	1,518	800	(5)
(6) Nyasaland ..	4,615	5,422	4,036	6,873	7,718	4,976	2,792	4,470	6,095	9,331	4.205	(6)
(7) N. Rhodesia..	100	80	102	500	379	506	32	17	—	—	—	(7)
(8) S. Rhodesia ..	—	—	—	1,650	4,907	6,803	639	90	280	1,481	1,974	(8)
(9) Tanganyika ..	7,327	7,175	11,434	18,793	21,724	24,280	15,966	32,954	27,785	23.136	11,322	(9)
(10) Union of South Africa and Swaziland	2,923	2,740	6,523	8,730	16,936	20,381	10,242	11,013	9,774	16,213	8,123	(10)
(11) West Indies ..	4,763	4,314	5,295	4,309	4,186	5,941	6,076	4,088	5.312	5,672	5,106	(11)
(12) Queensland ..	792	3,140	9,344	11,850	14,318	7,179	5,880	10,266	6,296	13.999	12.189	(12)
(13) Cyprus ..	2,547	1,505	2,233	3,397	3,320	4,614	2,110	2,146	3,610	4.778	2,827	(13)
(14) Malta ..	582	193	118	573	782	507	342	541	379	293	201	(14)
(15) Iraq	60	300	1,100	2,400	2,540	3,500	1,800	5,200	4,700	3,300	960	(15)
(16) Fiji	—	—	85	157	123	824	356	114	271	398	240	(16)
(17) Ceylon ..	—	—	49	324	121	261	186	202	380	248	95	(17)
	166,154	112,795	174,697	263,252	360,523	432,935	355,248	358,137	464,881	412,230	378.804	
		Percentage Decrease 32·1.	*Percentage Increase* 54·8.	*Percentage Increase* 50·6.	*Percentage Increase* 36·9.	*Percentage Increase* 20·0.	*Percentage Decrease* 17·9.	*Percentage Increase* 0·8.	*Percentage Increase* 29·8.	*Percentage Decrease* 11·3.	*Percentage Decrease* 8·1.	

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

263. The following reports have recently been received:

Review of Agricultural Operations in India, 1928-29.
Indian Cent. Cott. Committee Ann. Rpt., 1931.
AGRA AND OUDH: Rpt. on Admin. of Dpt. of Agr., 1931.
PUNJAB: Fifth Progress Rpt. Punjab Botanical Scheme, 1929-30.
  Ann. Rpts. for 1930 for various Stations.
PUSA: Sci. Rpts. of Imp. Inst. of Agr. Res., 1930-31.

264. REVIEW OF THE AGRICULTURAL OPERATIONS IN INDIA, 1928-29. (Govt. of Ind. Cent. Pubn. Branch, Calcutta, 1931. Report received 1932.) *Cotton.*—During the year under review the area under cotton was 27,053,000 acres, but owing to damage by frost to the Broach, Dholleras, and Punjab-American crops, the yield was estimated at only 5,811,000 bales of 400 lb.

The work of the Indian Central Cotton Committee in the promotion of research in connection with cotton-growing, the improvement of cotton marketing, and the prevention of malpractices, is described. An account is also included of the research work that is being carried out in the various Provinces and States. In the section devoted to Co-operative Cotton Sale Societies, it is stated that the societies continue to prosper in Bombay, have made a start in Madras, but have not made progress in other Provinces.

265. INDIA. *Cotton Cultivation*, 1930-31. (*Ann. Rpt. of Ind. Cent. Cott. Comm.*, 1931, p. 10.) The area planted to cotton was 23,616,000 acres, as against 25,922,000 acres in 1929-30. This decline was mainly due to low prices ruling during the preceding season. The season was good on the whole, although the crops in the Bombay-Karnatak, Gujarat, and Hyderabad were reported to have suffered considerably from pests, diseases, and unfavourable weather conditions. The total estimated yield was 4,820,000 bales of 400 lb. as compared with 5,125,000 bales for 1929-30. The average yield per acre was 82 lb. as against 79 in 1929-30.

266. INDIA. By Sir William Himbury. (British Cotton Growing AssCn., 1932. Price 1s.) An interesting account of a visit to India, dealing more especially with the work of the British Cotton Growing Association's farm at Khanewal. A memorandum is included on the Lloyd Barrage at Sukkur. The report is well furnished with illustrations.

267. INDIAN COTTON. (*Text. Rec.*, xlix., 587, 1932, p. 30.) A discussion of the present position. The two big problems confronting cotton-growers in India may be summarized as follows: (1) India is capable of growing its own present mill requirements of long-staple cotton, but will it pay the grower in every case? (2) If staple cotton replaces the short-staple varieties at present grown, what effect will that have on the price of the two commodities?

268. INDIAN CENTRAL COTTON COMMITTEE. (*Ann. Rpt. to August* 31, 1931.) Describes the work of the year in connection with the Cotton Transport Act and Cotton Ginning and Pressing Factories Act, malpractices, finance of the cotton crop and primary cotton marketing, cotton markets, marketing of improved varieties of cotton, prevention of the introduction of foreign cotton pests, cotton statistics. The most striking feature of the year was the development of the research work of the Committee. Seven new schemes were sanctioned and one more was approved. In all thirty-three schemes are being financed at an estimated cost of Rs. 6,83,843 per annum. Full details are given, in the latter part of the report, of the research schemes, seed extension schemes, the work of the Indore Station, Technological Laboratory, etc.

269. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS. By N. Ahmad. Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include Agricultural Details, Grader's Report, Fibre Particulars, Spinning Tests, Remarks and Conclusions.

1. *Umri Bani*, 1931-32.—Area under cultivation, 98,800 acres under Government seed and 630,000 acres under cultivators' seed. The 1931-32 cotton, though not so clean as that of the previous season, has given equally strong yarn. It is suitable for 27's warp.
2. *Verum* 262 (*Akola*).—Area under cultivation, 164,800 acres. This season's cotton, although similar in fibre-properties to the previous season, has given a slightly better performance. It is suitable for 21's warp.
3. *Verum* 262 (*Nagpur*).—Area under cultivation, 164,800 acres. This cotton has completely recovered from the decline in spinning performance witnessed in 1929-30. It is suitable for 25's warp.
4. *Punjab-American* 289 *F*.—Area under cultivation in 1930-31 was approximately 14,000 acres. Except for the neppiness of its yarns, this cotton has generally given good results. It is considered suitable for 39's warp.
5. *Punjab-American* 4 *F*.—Area under cultivation, 741,000 acres. This cotton has recovered from the setback of 1928-29. It is suitable for 20's warp.

270. SPINNING TEST REPORTS ON INDIAN COTTONS. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs. Nos.* 60, 63, and 64, 1931-32.) The circulars contain the grader's report and spinning test results for Dhulia (Khandesh), Ujjain, and Khandesh cottons for the 1931-32 season.

271. LIST OF COTTON-PRESSING FACTORIES, WITH NAMES OF OWNERS AND PARTICULARS OF MARKS ALLOTTED TO THEM IN THE DIFFERENT PROVINCES OF BRITISH INDIA AND CERTAIN INDIAN STATES, FOR THE SEASON 1931-32. (Govt. of India Cent. Pubn. Branch, Calcutta, 1932. Price As. 14, or 1s. 6d.)

272. C. 402, A NEW VARIETY OF LONG-STAPLE COTTON IN THE UNITED PROVINCES OF AGRA AND OUDH. By R. Prasada. (*Bull. No.* 58, Allahabad, 1931.) Describes the completion of work, originally started by Dr. Martin Leake, which has resulted in the production of a variety of cotton, C. 402, with improved length of lint, good ginning out-turn, and quality that makes it suitable for 16-20's warp.

273. AGRA AND OUDH. *Cotton Cultivation.* (*Rpt. on Admin. of Dpt. of Agr.*, 1931, recently received.) "Cawnpore spinning mills consume a large quantity of long-stapled cotton imported from other provinces, and with a view to meeting this demand, in part, from within the provinces, compact blocks of C. 402 have been grown as an experiment. This variety may not be a substitute for Coomptas, Westerns, and Ujjains, but it can replace, in limited quantities, Punjab-Americans and Oomras. It is a high ginning cotton with a fibre length of $\frac{7}{8}$ in., and capable of being used in 18's mixing. In 1927-28 and 1928-29, 95 bales of lint were sold to different mills in Bombay, Hathras, and Cawnpore at 25 to 50 per cent. higher rates than those of Bengals (*desi* cotton grown in these provinces). In 1929-30 and 1930-31 the purchase of cotton was financed by short-term advances placed at the disposal of the Director of Agriculture."

A discussion is given of the marketing problem, but the slump in prices has rendered progress impossible at present.

The Government Entomologist has practically completed his investigation on the pink bollworm, and it is hoped that in the near future adequate measures will be taken to deal with this widespread pest.

274. COTTON IN THE PUNJAB. (Dpt. of Agr., Punjab, Ann. Rpts. from various Stations, 1930.) The following experiments are described: Yield trials with Mollisoni cotton at Gurdaspur Station : varietal, cultural, broadcast *v.* sowing in lines, manurial, continuous cropping tests at Hansi Station; rotational, varietal, manurial, and spacing trials at Lyallpur Station. In seed testing experiments carried out at this Station it was noticed that American cottons contained a very high percentage of immature seeds. Other experiments described include: Varietal, manurial, irrigation, and yield trials at Montgomery Station; varietal, sowing date, broadcast *v.* line-sowing experiments at Multan Station; varietal, irrigation, and flat *v.* ridging tests at Sirsa Station. At Rawalpindi Station the cotton crop did not make much progress owing to a severe hailstorm and attacks of whitefly.

275. PUNJAB BOTANICAL RESEARCH SCHEME: FIFTH PROGRESS REPORT, 1929-30. By T. Trought. A summary of the conclusions drawn in various papers already abstracted.

[*Cf.* Abstr. **527**, Vol. VII., and Abstrs. **175**, **186**, **353**, Vol. VIII.]

COTTON IN THE EMPIRE (EXCLUDING INDIA).

276. The following reports have recently been received:

GOLD COAST: Gold Coast Year Book, 1930.

SUDAN: Ann. Rpt. of Dpt. of Agr. and Forests, 1930.

277. THE FUTURE OF THE EMPIRE MARKETING BOARD. (*W. India Comm. Circ.*, xlvii., **875**, 1932, p. 143.) Contains the recommendations of the Select Committee on Estimates.

278. ACCOUNT OF THE RESEARCH IN PROGRESS IN THE BRITISH EMPIRE. (Imperial Bureau of Plant Genetics, Cambridge, 1932. Price 3s. 6d.) The work is arranged under crops, these being classified according to the Universal Decimal Classification. Within each crop the work is subdivided according to the country in which it is being done. The countries are also arranged according to the Universal Decimal Classification. For convenience of reference an index is given on both subjects and countries. The research work on cotton in India, Iraq, Burma, Sudan, Sierra Leone, Gambia, Gold Coast, Nigeria, Uganda, Tanganyika Territory, Rhodesia, Nyasaland, West Indies, Straits Settlements, Queensland, and Fiji, is dealt with on pp. 38 to 45 of the publication.

279. COLONIAL AGRICULTURE. By F. A. Stockdale. (*Crown Colonist*, i., **3**, 1932, p. 112.) A general account of what is being done to aid colonial agriculture, given under the heads of : Recent Developments; The Scholarship Scheme; Work of the Advisory Council: Research Work in Progress; Agricultural Conferences and Bureaux; Marketing; Agricultural Education.

280. ASIA: CEYLON. *Cotton Cultivation.* (*Crown Colonist*, i., **3**, 1932, p. 119.) "Cotton growing has secured a foothold in the southern part of the island and is receiving every encouragement from the Government. The Agricultural Department have carried out numerous experiments on seeds, and have arrived at conclusions as to which varieties are best suited to local conditions. Considerable interest has lately been taken in weaving and spinning locally."

281. IRAQ TO THE SUDAN, 1932. By Sir William Himbury. (British Cotton Growing Assn., 1932. Price 1s.) An account of a visit paid to Iraq, Palestine, Egypt, and the Sudan, dealing chiefly with the cotton industry in Iraq and in the Sudan. The report is well illustrated.

282. AFRICA: EAST AFRICA. The Eighth Ann. Rpt. of the Joint East African Board contains an account of the work carried out during the year 1931 with a view to promoting the agricultural, commercial, and industrial development of the East African territories. Among the matters discussed are the question of railway rates on Uganda cotton, and the problems of the sisal industry. Included with the report is a memorandum on the Locust problem in East Africa, by Dr. Uvarov, dealing briefly with the present situation, immediate control measures, and further outlook.

283. GOLD COAST. *Cotton Investigations*, 1930-31. (*Gold Coast Year Book*, 1930, pp. 166 and 309.) Work at the Tamale Station is described by J. E. Symond and T. L. Williams. The strain D28 has maintained its promise and increased its yield. Of new varieties tried, only two Asiatics, Coconodas and Karunganni, showed any promise, and it is hardly to be expected that the low prices usual for these strains would give an economical return. Further purification of the varieties T66 and T57 will be necessary before bulk trials can usefully be attempted. Trials with artificial manures showed that the best results were obtained with basic slag used in conjunction with kainit. The beneficial effect of a previous green manure crop was clearly shown in the rotation experiment.

In their report on the Kpeve Station, H. K. Hewison and C. W. L. Line state that Improved Ishan cotton has given good results, and special seed plots are being established.

284. NIGERIA. *Cotton Cultivation*, 1931-32. (*Half-yearly Rpt. to* 31*st March*, 1932, Dpt. of Agr., Nigeria.) *Northern Provinces.*—The low prices paid for cotton and the high prices paid for guinea corn and other food crops, and the fear of further locust invasion, caused an increased area to be planted under food crops at the expense of cotton. It is believed, however, that the pendulum would not have swung so far against cotton had it not been for pressure being brought to bear on the farmer to plant food crops. Events showed that this pressure was ill-advised. The season was a very favourable one for all food crops, damage by locusts was negligible, and at the moment food is exceptionally, even absurdly, cheap. As a result, the proceeds from the sale of guinea corn have hardly enabled the farmer to pay his taxes, while the railway has lost the revenue which an export crop such as cotton would have brought in. Taking into consideration the cost of transport and marketing, cotton at anything over ½d. per lb. is just as profitable to the native as guinea corn at ⅓d. per lb., and cotton has the advantage that it can be planted at a time when the farmer is not busy with his food crops. The farmer will use his own judgment this year, and it is already evident from the way seed is being taken that he intends to grow more cotton again.

The quality of the lint was not as good as usual, owing to the early cessation of the rains and the severe Harmattan. Ginning percentage was high, the average being between 30 to 31 per cent.

Arrangements have been made to date for the distribution of about 1,400 tons of seed for the 1932-33 season, but it is being taken up so readily that the total quantity distributed will probably exceed this figure.

Southern Provinces.—The yield during the 1931-32 season was generally lower, perhaps by 10 per cent., than normal. Less acreage was planted on account of last year's low prices. This season new grading regulations come into force, and the grades for Southern Nigerian Ishan cotton are now in line with those for Nor-them Nigerian Allen cotton. In an effort to stimulate the harvesting of cleaner cotton required by the higher standard for the Ishan grades, some 400 picking bags have been sold at twopence each to native farmers and middlemen, and seem to have been used to good effect.

285. THE MAINTENANCE OF SOIL FERTILITY IN SOUTHERN NIGERIA. By C. J. Lewin. (*Third Special Bull. of Agr. Dpt., Nigeria*, 1931.) The author states that the pamphlet is written primarily with the intention of summarising the results of experiments on the maintenance of soil fertility at various agricultural stations in the Southern Provinces, for the benefit of Agricultural Officers newly appointed to Nigeria. It is believed, however, that many of the experiments described may be of interest to agriculturists in other parts of the tropics. The various chapters deal with Green Manuring at the Experiment Stations; The Maintenance of Fertility; The Efficiency of Various Legumes as Green Manures; The Management of Green Manures; Green Manuring and the Native Farmer.

286. SOUTHERN RHODESIA. *Cotton Cultivation*, 1930-31. By G. S. Cameron. From the report of the Cotton Specialist we learn that the season was in general very dry, which caused much shedding of buds and flowers. The area planted was 9,028 acres, which yielded 2,708,997 lb. of seed cotton, an average of 300 lb. seed cotton per acre. This was slightly above the yield per acre of the previous season, but taking into account the severity of the drought conditions in the Hartley district, which must have tended to lower the average, the yield was well above the average of the previous seven years. This satisfactory state of affairs is attributed to the fact that only the U.4 variety of seed is now grown in the country, and the closer spacing in the row, combined with the use of a heavier seed rate, is having the desired effect of increasing the yield per acre. There was a distinct improvement in the "character" of the cotton produced during the year.

Four ginneries operated during the season. The services of the Seed Cotton Classifier were much appreciated in connection with the classification of seed cotton, the work being carried out in a most efficient manner. The Central Cooperative Cotton Exchange at Durban again proved of great service in disposing of the crop.

At the Cotton Breeding Station, Gatooma, the drought did more to reduce yields than did the attacks of bollworms. In comparison with former years, jassid attack was relatively mild. In addition to the usual work of the Station, a beginning was made with extension work whereby records were collected from other districts. This necessitated the creation of sub-recording centres on farms where plots were laid down by several progressive cotton-growers, who willingly co-operated with the staff of the Station. Records on the sub-stations were taken by native recorders trained at Gatooma. When initiating this line of work it was not known what reliance could be placed on records so taken, but it is satisfactory to state that these exceeded expectations on three out of the four sub-stations where the native recorders were placed. Useful information regarding seasonal development, responses to cultural practices, behaviour of sub-strains, and insect attacks, was obtained, and used for comparison with results on the main Station at Gatooma.

Prospects for the Current Season.—Mr. Cameron reports that owing to low prices plantings will be on a more moderate scale. It is anticipated that the area under ratoon cotton will be increased. Farmers generally are not in favour of ratooning, but conditions being as they are, it is difficult for them to do otherwise. In the event of even a moderate recovery in prices there is reason to hope that the acreage will materially increase next season, as farmers have now regained confidence in their ability to grow cotton. This in itself is a very distinct advance, as it has been difficult to eradicate the impression created during the bad years of 1925 and 1926. It is safe to say that cotton-growing in Southern Rhodesia will readily respond to any general improvement in world economic conditions.

287. SOUTH AFRICA. *Crop Prospects.* From a report recently received we learn that in many districts the cotton crop prospects are poor owing to the severe drought.

288. TANGANYIKA TERRITORY. *Cotton Prospects for* 1932. The crop report of the Dept. of Agriculture for March states that less cotton has been planted in Lindi and Mikindani, but the acreage has been increased in the Rufiji area. Cotton prospects in the Morogoro, Kilosa, and Mwanza districts are good.

289. UGANDA. *Cotton Experiments.* (*Bull. of Imp. Inst.*, xxix., **4**, 1931, p. 470.) According to a report on the Bukalasa Experiment Station for the first half-year of 1931, the experimental work on cotton was confined chiefly to cultural experiments, viz., sowing date and spacing, sub-soiling, mulching, ridging, lime and green manure, crop residue, and interplanting experiments, and a "blackarm" experiment. In the crop residue experiment, which was designed to determine the effect on the soil of growing various food crops, the food crops chosen were maize, groundnuts, beans, simsim, and sweet potatoes. These were grown on the same plots year after year, while the effect was measured by the yields of cotton taken off the plots every second season. The yields obtained from cotton in the 1930-31 season showed a marked significant difference in favour of cotton grown after sweet potatoes. This may be due to the more thorough cultivation of the soil when the potato crop was harvested.

290. AUSTRALASIA: FIJI. *Cotton Industry* 1931. (*Int. Cott. Bull.*, x., **38**, 1932, p. 182.) It was estimated that the cotton crop would be small, owing to storm and flood damage early in the year. Legislation was promulgated in September last, providing for all cotton planted before April, 1930, to be uprooted and burned. The planting season was fixed from October 15, 1931, to February 29, 1932. These measures were taken to control cotton pests.

291. WEST INDIES. *Sea Island Cotton.* (*Trop. Agriculture,* ix., **4**, 1932, p. 93.) A general discussion of the factors responsible for the serious plight of the Sea Island cotton industry. The formation of a West Indies Sea Island Cotton Growers' Association has been suggested with a view to controlling production, finding new uses for the cotton, collecting and disseminating statistical information, carrying out propaganda, and generally doing such work as would be of help to the industry as a whole. It is also hoped that the forthcoming Conference will help to solve some of the problems confronting the industry.

292. BARBADOS. *Cotton Conference.* (*W. India Comm. Circ.*, xlvii., **876**, 1932, p. 168.) At the Conference held in April, the Governor of Barbados stated that there was every prospect of the Sea Island industry in the West Indies becoming unremunerative and possibly even extinct unless growers could find some way of helping themselves. He mentioned three alternative remedies: (1) To maintain the cultivation of Sea Island cotton and to take all action possible to secure (*a*) a uniformly high standard of lint, (*b*) extended manufacture, and (*c*) increased demand by the public for articles manufactured from this variety. (2) To abandon cotton cultivation, and seek some other remunerative product. (3) To substitute for Sea Island another variety, medium or short staple.

293. *Cotton Cultivation.* (*W. India Comm. Circ.*, xlvii., **870**, 1932, p. 55.) The cotton trees have flowered freely, but are not tall enough. No field to field search has, as yet, been carried out by the Dept. of Agriculture, but as far as is known, no pink bollworm has been discovered. This is an illustration of what thorough and drastic methods can do in the stamping out of even stubborn pests.

294. ST. VINCENT. *Cotton Prospects.* The latest report received is to the effect that the return per acre of Sea Island cotton for the 1931-32 season will fall short of that obtained the previous season. The percentage of stained cotton will not be large. Insect pests were not plentiful and fungoid diseases normal.

COTTON IN EGYPT.

295. EGYPTIAN COTTON: PRICE. (*Text. Weekly*, 8, 1932, p. 567.) Recently the price of Uppers in Alexandria has actually been less when converted into sterling than the price of American in Liverpool. Even the price in Liverpool, including freight and so forth, has frequently been less than a penny a pound above that of American. The world's consumption of Egyptian cotton normally averages a little under a million bales, but this declined in 1929-30. For the first half of 1930-31 the figure was only 394,000 bales, and only 853,000 bales for the whole season. This was partly due to the general restriction of consumption, but it was also directly attributable to the relatively high price of Egyptian, due to Government intervention. The world's supply of Egyptian cotton for this season (crop plus carry-over) will amount to considerably more than twice last season's consumption. The future of Upper Egyptian cotton lies in the direction of increased competition with the better grades of American. As the yield of Upper Egyptian is the heaviest in the world, this should not be difficult, provided growers bear in mind that the relative price is the determining factor. It is hoped that in the new Giza 7 variety Egypt may find the fortunate combination of a yield as high as that of Uppers with a quality approaching that of all but the best types of Sakel. Diagrams showing the movements in prices of Sakel and Uppers in January, 1932, are given.

296. A STATISTICAL STUDY OF SOME OF THE FACTORS AFFECTING THE PRICE OF EGYPTIAN COTTON. By M. A. Zahra and M. El-Darwish. (*Tech Bull. No.* 1, *Min. of Fin.*, Govt. Press, Cairo, 1930.)

297. COTTON GROWING IN EGYPT. (*Nature*, Vol. 128, No. 3241, 1931, p. 1001.) A criticism by Mr. N. W. Barritt of Mr. Slater's review of recent publications on the working of the Seed Control Law in Egypt.

298. LA LUTTE CONTRE LA CRISE COTONNIÈRE EN EGYPTE. By Fouad Bey Abaza. (*Soc. Belge d'Études et d'Expansion, Bull. No.* 83, 1931. Abstr. from *Bull. No.* 6, *Assoc. Coton Colon.*, 1932, p. 74.) The essential factor in overcoming the crisis is the peasant cultivator, of whom the Congress of 1927 remarked: "The Congress places on record its appreciation of the patient, painstaking, and persevering work which the fellaheen carry out so efficiently in connection with cotton cultivation."

299. WATERING AND SPACING EXPERIMENTS WITH EGYPTIAN COTTON. By J. Templeton. (*Bull. No.* 112, *Tech. and Sci. Serv.*, *Min. of Agr.*, *Egypt*, 1932.) In the early days of cotton cultivation in Egypt water shortage was liable to occur during the hot months of June and July—*i.e.*, before the arrival of the Nile flood. In order to tide the plants over this period, cultivators adopted the practice of delayed watering of the seedlings in order to force them to develop deep root systems which could draw on the subsoil water. After the seed was sown and watered no further water was given for a period of from six to eight weeks, and this is the normal practice at the present day. This results in the loss by shedding of the early flower buds—a disadvantage which in the old days was of little account as the plant could make up for the loss later in the season, which then extended up to December. The danger of water shortage in June and July has, however, long ago disappeared, owing to the great developments in irrigation, with the construction of dams, barrages, etc., so that the main condition which prompted the adoption of this method of irrigation no longer exists.

Another argument against subjecting the seedlings to prolonged water strain—with consequent loss of the early buds—is that about twenty years ago the pink bollworm appeared, and it completely destroyed the later pickings. Since the advent of this pest any loss in the early part of the season cannot now be made good later on, and it has, in fact, effectively curtailed the growing season. It is therefore obvious that any means of making the crop earlier are of the greatest importance, and in this connection experiments on watering and spacing have been carried out. Results show that by watering three weeks after sowing, combined with heavy watering at the beginning of July, the crop is earlier and increased yields are obtained. Spacing experiments have shown that—within certain limits—the closer the spacing the earlier the crop. From the results, it is concluded that the optimum spacing is now 35 cms. between the holes and 65 cms. between the ridges, as opposed to 45 by 75 cms. in pre-bollworm days.

[*Cf.* also p. 213, above.]

COTTON IN THE UNITED STATES.

300. Transacting Cotton Business on Net Weight Basis. (*Int. Cott. Bull.*, x., **38**, 1932, p. 205.) The American Cotton Co-operative Association has resolved, through its board of directors, to use every effort to obtain passage of a net-weight bale through Congress at this session, and similar action has been taken by the American Cotton Manufacturers' Association and the Cotton Textile Institute.

301. How Long? By W. L. Clayton. (*Int. Cott. Bull.*, x., **37**, 1931, p. 55.) An interesting analysis of what the author considers the weakness of the position taken up by the United States Government in regard to cotton.

302. Le Coton Dans le Monde. By J. Ausset. (*Coton et Cult. Coton*, vi., **3**, 1931, p. 233.) A statistical discussion of the present position in regard to American cotton, including carry-over, the work of the Federal Farm Board, etc.

303. Visit to the U.S. Cotton Belt, 1931. By N. S. Pearse. (*Int. Cott. Bull.*, x., **37**, 1931, p. 61.) The author states that although the acreage planted was 10 per cent. less than the previous season, the higher yield (due to unusually good climatic conditions) indicates a greater total output. The average length of staple has increased by $\frac{1}{32}$ to $\frac{1}{16}$ in. Much of the report is devoted to the consideration of political measures.

304. Alabama. *Cotton Experiments.* (*Ann. Rpt. of Agr. Exp. Sta., Alabama*, 1931.) Results are given for the following: Varietal trials, rotation experiments (cotton, oats, and corn), and fertilizer experiments—nitrate of soda *v.* ammonium sulphate, ammonium sulphate and sodium nitrate *v.* sodium nitrate alone, basic slag *v.* superphosphate. The use of the rotary hoe for cultivation of young corn and cotton on sandy soils during a favourable season greatly reduced cultivation costs. A one-horse spring-tooth weeder was used to break crusts on cotton just coming up, and aided in getting up a stand of cotton. It was found that one man and one mule could cover 20 acres a day with this machine.

305. California. *Cotton Cultivation.* (*Southern California Crops*, viii., **2**, 1932.) No definite estimate can be given as to the acreage that will be planted to cotton this season, but every indication points to a substantial decrease.

306. COTTON GROWING IN CALIFORNIA. By H. H. Schutz. (*Int. Cott. Bull.*, x., 38, 1932, p. 195.) Approximately 93 per cent. of Californian cotton is now grown in the San Joaquin Valley, the average yield for the past five years being 530 lb. per acre. Smaller acreages are found in the Palo Verde, Bard, Imperial, and Coachella valleys. Owing to the high cost of cultivation, with the water charge alone ranging from $5·00 to $12·00 an acre, it is seldom profitable to plant cotton unless the yield is at least three-fourths of a bale and the price above 12 cents a pound. Acala cotton, with a staple length up to $1\frac{1}{8}$ ins., is well adapted to prevailing conditions.

307. GEORGIA. *Cotton Experiments*, 1931. (*Ann. Rpt. of Exp. Sta., Ga.*, 1931.) Includes results of experiments with fertilizers, with varieties, and with seed treatments. It was found that various dusts, especially Ceresan, were effective in the control of seed-borne diseases.

308. GULF SOUTH-WEST. *Cotton Production and Distribution.* By E. F. Gerish. (*Text. Rec.*, xlix., 586, 1932, p. 80.) Approximately 1,000,000,000 dollars are made available every year by the sale of cotton, and about 5,000,000 people share in this sum.

309. LOUISIANA. *Ann. Rpt. of North Louisiana Experiment Station,* 1931. Gives the result of fertilizer, spacing, rotational, and varietal trials with cotton. Very heavy yields of over a bale to the acre were obtained from land used alternately for corn, soybeans, and cotton.

310. *Biennial Rpt. of the North-East Experiment Station,* 1930-31. Includes accounts of experiments with cotton which are, as yet, unfinished.

311. SOUTH CAROLINA. *Relation of Price to Quality of South Carolina Cottons, 1929-30 Season.* By M. Guin. (*S. Car. Sta. Bull.* 279, 1931. Abstr. from *Exp. Sta. Rec.*, 66, 2, 1932, p. 189.) The prices paid in the central markets showed quite large premiums for the grades above middling and staples longer than $\frac{7}{8}$ in., and large discounts for the lower grades and shorter staple lengths.

312. TEXAS. *Cotton Investigations in Texas.* By D. T. Killough *et al.* (*Texas Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 66, 1, 1932, p. 29.) Mebane and its related strains, such as New Boykin, Harper, Chett Superior, Kasch, and Qualla; Lone Star and its strains; Truitt; and Acala types of cotton continued to be the best varieties for Texas conditions. Delfos and Lightning Express cotton, with longer staple, appeared specially well suited to conditions in the more humid parts of the Gulf Coast section.

Cotton spaced 9 in. apart in the row produced the highest yield over a period at Spur, but only slightly higher than from spacings of 12, 15, and 18 in. In dry years the wider spacing made materially larger yields. At Lubbock, cotton planted in paired rows or with every third row uncropped yielded only 79 per cent. as much lint as when each row was planted as usual. For the past decade on the fine sandy loam on the station, late preparation gave slightly better yields than fall or winter preparation with both cotton and grain sorghum. Ploughing 7 in. deep proved better than 3·5 in. deep, and also better than listing deep or shallow.

During three years at Troup 8-12-4 fertilizer at the acre-rate of 400 lb. outyielded other grades at the same rate, but not enough to be as profitable as 4-6-4 or 4-8-4 mixtures. Ammonium sulphate was more profitable than equivalent amounts of sodium nitrate or cotton-seed meal. Applying all fertilizer in the drill before planting resulted in larger yields than when one-half the nitrogen was side-dressed after chopping. Fertilizers, besides increasing lint yields, also increased the size of boll, percentage of 5-lock bolls, and the percentage of shedding, but did not seem to affect the length of lint.

813. TEXAS FARMERS SLEDDING COTTON. (*Int. Cott. Bull.*, x., **38**, 1932, p. 207.) Southern Texas farmers began sledding their cotton in December, owing to the shortage of labour. Dozens of sleds, drawn by horses, made their appearance in the fields, while a few tractor-driven machines were used.

814. MODERN COTTON-GINNING INDUSTRY IN THE UNITED STATES OF AMERICA. By W. S. Federow. (Issued by All Union Res. Cotton Inst., Tashkent., U.S.S.R., 1931.) A detailed report with many illustrations, and a good English abstract.

815. AMERICAN COTTON MILL: OPERATING EFFICIENCY INVESTIGATION. (*Cotton*, U.S., **96**, 1932, p. 37. Abstr. from *Summ. of Curr. Lit.*, xii., **6**, 1932, p. 161.) The results of checks on weights, drafts, speeds, twists, production, ends down, stoppages, waste, etc., in processes from scutching to weaving in a mill using Low Middling cotton, $\frac{3}{4}$ to $\frac{15}{16}$ in. staple, making 28's warp and 30's weft for 5·60 to 6·10 yard sheeting are given, and the causes of variations are indicated.

816. TEXTILE RESEARCH: ORGANIZATION IN U.S.A. (*Text. World*, **80**, 1931, p. 2182. Abstr. from *Summ. of Curr. Lit.*, xii., **3**, 1932, p. 70.) The U.S. Institute of Textile Research has issued a questionnaire to 1,435 industrial concerns, educational institutions and government departments about the research work undertaken by them. Of 661 replies, 267 reported that such work was being done, covering a total of 584 problems. These are classified as 57 per cent. physical, 31 per cent. chemical, and 10 per cent. economic, and 54 are described as "fundamental." There appears to be much duplication of effort.

COTTON IN FOREIGN COUNTRIES.

817. CULTURE ET COMMERCE DU COTON. By F. Sparano. (*Bull. Agr. du Congo belge*, xxii., **3**, 1931, p. 386.) The annual report of the cotton industry, Belgian Congo, for the 1930-31 season.

818. L'ÉGRENAGE ET L'EMBALLAGE DU COTON AU CONGO BELGE. By A. Nolf and M. Pilette. (*Bull. Agr. du Congo belge*, xxii., **4**, 1931, p. 459.) A well-illustrated description of the cotton ginning and baling presses in use in the Belgian Congo, with instructions as to their working. There are sixty-four ginneries in operation in the country.

819. BRAZIL. *Trade Prospects.* (*Text. Rec.*, xlix., **596**, 1932, p. 83.) It is pointed out in the "Notes from Brazil" that there are good opportunities for British trade now that the gold standard has been abandoned.

820. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No.* 5 contains the following among other articles:—"Les conditions de la culture du coton en Syrie," by E. Achard; "Le cotonnier dans les îles françaises du Pacifique Austral," by J. Risbec (both articles continued in No. 6). Short papers on "Mission scientifique Sahara-Niger-Soudan," by A. Chevalier, and "La recherche cotonnière en Afrique Equatoriale Française," by W. J. Lugard. Notes on cotton in Algeria, Syria, Belgian and Portuguese colonies, etc., and on cotton legislation are also included. *Bull. No.* 6 contains, among others, the following papers: "Les insectes du cotonnier au Maroc," by M. Carle; "Le coton soviétique" and "Améliorations de la culture du cotonnier en Asie Centrale Russe." Notes on cotton in Algeria, Morocco, Indochina, etc., cotton legislation, and other matters, are included.

821. DIRECTIVES DE LA CULTURE COTONNIÈRE EN AFRIQUE OCCIDENTALE FRANÇAISE. By R. H. Forbes. (*Coton et Cult. Coton.*, vi., **3**, 1931, p. 173.) An interesting account, with tables showing yields of the various cottons cultivated. The problem of improving varieties has been sufficiently solved to justify developments on a large scale. Cultural methods, rotation of crops, and maintenance of soil fertility have all been studied.

Étude Technologique de Cotons Pima Cultivés au Maroc. By F. Heim de Balsac and E. Miège. (*Coton et Cult. Coton.*, vi., 1931, p. 199.) Figures are given for hair length, fineness and strength for strains of Pima cotton grown in Morocco in 1930.

323. Les Cotons de Moyenne et de Longue Soie. (*La France Textile*, Octobre, 1931. Abstr. from *Bull. No.* 6 *Assoc. Coton. Colon.*, 1932, p. 72.) France is stated to be the country which, in proportion to its number of spindles, uses the greatest quantity of long and medium staple cottons.

324. Examen Technologique de la Fibre de Quelques Cotonniers Expérimentés au Soudan Français et de Leurs Hybrides. By J. Szymanek and O. Roehrich. (*Coton et Cult. Coton.*, vi., 1931, p. 187. Abstr. from *Summ. of Curr. Lit.*, xii., **8**, 1932, p. 222.) The results of a technological examination of a number of cottons and their hybrids grown in the French Sudan are reported. The cottons to which the experiments refer are Allen and Hartsville (*G. hirsutum*), Ishan and Munshi (*G. vitifolium* or *peruvianum*) and Garo Hills and Karunganni (*G. herbaceum-indicum*). Native cottons classed as *G. punctatum* were used for comparison, and the cottons were also crossed with the native varieties Koriba and Korini. The results are for the first generation after crossing only. Barouëli cotton, a variety of uncertain genealogy, was also included in the investigation. The results show that crossing between the different species is not as limited as has been indicated, though it may sometimes be difficult to bring about; fertile hybrids have been obtained by crossing *G. hirsutum* and *G. herbaceum-indicum* and *G. vitifolium* and *G. herbaceum-indicum*. Particular attention is drawn to the hybrid between Hartsville and native Saria, which is a function of the female gamete. Of the cottons examined, Barouëli was found to be the best, then Hartsville, which was definitely superior to Allen. Ishan does not do well in the French Sudan. The native varieties have a low ginning outturn. Of the *Indicum* cottons, Karunganni might be satisfactory in certain regions by reason of its high ginning percentage and staple length. The effect of variety on the trend of the staple length curve is noted, and the question of obtaining help from these curves in determining the origin of a cotton is raised.

325. The German Textile Industry in 1931. By A. Niemeyer (*Text. Rec.*, xlix., **587**, 1932, p. 29.)

326. Dutch Fibre Research Institute: Equipment. (Pamphlet *Eenige Mededeelingen betreffende den Rijksvezeldienst*, 1931. Abstr. from *Summ. of Curr. Lit.*, xii , **3**, 1932, p. 70.) An illustrated account of the machines comprising the equipment of the Institute. Machines for the examination of fibres include the Balls' sorter, Krais dynamometer, Schopper conditioning apparatus, and Leitz microprojection apparatus; for the examination of yarns, the Goodbrand lea tester, Schopper dynamometers, Tarnagrocki dynamometer for testing strong yarns of long fibres such as manila and sisal, de Vooys' ballistic tester and Schopper twist tester; and for the examination of fabrics, Schopper dynamometers, the Buskop tester, a folding test apparatus due to de Vooys, apparatus for determining the permeability of fabrics to air, a " hammer apparatus " for testing filter cloths, and a Hanau quartz-mercury lamp.

327. Russian Cotton: Production. (*Text. Weekly*, **8**, 1932, p. 542. Abstr. from *Summ. of Curr. Lit.*, xii., **5**, 1932, p. 119.) The official Russian estimate of 2,050,000 bales for the 1930-31 crop is considered much too optimistic in other countries, and the estimate of an increase of 80 per cent. over the 1930-31 crop for the 1931-32 crop is also regarded as improbable. The Russian Government is making strong endeavours to promote the cultivation of Egyptian cotton. A recent decree provides for a total area under cultivation in 1932 of 250,000 acres, and in 1933 of 340,000. The most important region under this scheme is the Sarai-Kamarsk district near the Afghanistan border. In order to stimulate the growing of Egyptian cotton the decree provides for crops being taken over at preferential prices, and for the demands of cultivators for agricultural and industrial products being given prior consideration.

328. PRINCIPAL RESULTS OF THE WORK OF THE KHERSON EXPERIMENT STATION WITH COTTON By V Vjelizhev (*Bull Sci Res Cott Inst.*, Tashkent, **7-8**, 1931, p. 10. Abstr in *Plant Breeding Abstracts*, ii, **2**, 1932, p 80)

329. THE RED STAR IN SAMARKAND. By A L. Strong (Williams and Norgate.) An interesting account of a trip to Samarkand, containing in one chapter a good description of the great co-operative association for dealing with cotton, which we have already noticed

[*Cf* Abstract **341**, Vol VII]

SOIL AND MANURES.

330. IMPERIAL BUREAU OF SOIL SCIENCE. *Rpt for the Year Ending March* 31, 1932 It is stated that there has been a noticeable increase in the amount of work done, and a steady demand for the publications of the Bureau.

331. THE SOIL By Sir A D Hall (Fourth edition, revised and enlarged London, John Murray, 1931 Price 9s Abstr from *Bull of Imp Inst*, xxix, **4**, 1931, p 500) The book follows in the main the plan of the earlier editions, the last of which appeared eleven years ago There is a short introductory chapter dealing in general terms with some of the chemical, physical, and biological factors involved in the study of the soil This is followed by chapters on the origin, classification, and mechanical analysis of the soil, and their relations with texture, tillage, and cultural operations The usual methods of chemical analysis of the soil are described in some detail, together with a discussion of the interpretation of the results obtained and their limitations The succeeding chapters deal with the micro organisms of the soil, especially in their relation to crop production, the absorption of fertilizer and other salts by the soil, the various causes and manifestations of fertility and sterility in soils, and methods of amelioration and reclamation of infertile soils The final chapter gives an outline of the classification of soils and of the more important soil types found in this country The book is up to date and well written, and should prove of great use to all interested in the study of the soil as the basis of the production of crops.

332. SOIL CONDITIONS AND PLANT GROWTH By Sir E John Russell (Longmans, Green and Co , London, 1932 Price 21s) This is the sixth edition of this important work It has been completely revised and largely rewritten All the more important of the recent advances on the composition of soil, its formation and classification, are included, as well as a full account of the work of the Russian School, which the author had the advantage of seeing during his visit to Russia last year. Many of the sections of the book have been revised in conjunction with the experts principally concerned There is a full discussion of the recent advances in the physico-chemical properties of clay, of humus and of soil, base exchange, acidity, flocculation, and the effects of cultivation Modern methods of soil examination in the field and laboratory are fully discussed.

333. SOILS AND FERTILIZERS By E. M. Crowther (Reprinted from *Rpts. of the Progress of App. Chem*, xvi., 1931.) A continuation of the previous review.

[*Cf*. Abstr. **492**, Vol. VII., 1930]

834. A HANDBOOK OF SOIL SCIENCE, III.-VIII. Edited by E. Blanck. (*Handbuch der Bodenlehre.* Berlin, Julius Springer, 1930. Abstr. from *Exp. Sta. Rec.*, 66, **1**, 1932, p. 12.) The first section of this work (*cf.* Abstr. **211**, Vol. VII.) is completed by volumes iii. to vii. Vol. iii. deals with weathering in relation to external climatic factors; vol. iv. with weathering and soil formation as dependent upon the geological subsoil and other natural factors, and surfaces of weathered fossil material; vol. v. with the soil as the uppermost layer of the earth's surface; vol. vi. with the mechanical make-up of the soil and the phenomena dependent thereon; vol. vii. with the chemical and geological nature of the soil. Vol. viii., which opens section 2, discusses cultivated soils, their characteristics and classification from the agricultural view-point, and the determination of the condition of the soil with respect to fertility.

835. AN IMPROVED SOIL SAMPLING TUBE. By H. J. Harper. (*Soil Sci.*, 32, **1**, 1931, p. 65. Abstr. from *Exp. Sta. Rec.*, 65, **9**, 1931, p. 811.) Finding soil tubes of the customary forms very difficult to remove from the soil because of (1) friction between the expanded portion of the tube and the soil-face, and (2) suction developed in moist soils when the tube is raised, the author of this contribution from the Oklahoma Experiment Station proposes a design characterized in part by a point tapering to the cutting edge and without an expansion near the point, a core so cut as to be smaller than the inside diameter of the main portion of the tube, and two oppositely placed ribs welded to the outside of the tube, by which, when the tube is revolved after it has been driven to the full depth to be sampled, the hole in which the tube stands is so far enlarged as to give free access of air to the bottom of the hole. The constructional details are fully described, and are shown in working drawings accompanying the note.

836. RAPID ESTIMATION OF WATER-CONTENT IN UNDISTURBED SOIL AND IN BALES OF COTTON. By W. L. Balls. (*Nature*, Vol. 129, No. 3257, 1932, p. 505.) The author writes: "An instantaneous method for estimating the moisture content of soil, at any particular spot below the surface of the ground, even approximately, should be very useful in plant physiology, irrigation, and in soil science generally. The high dielectric constant of water suggested to me that the variations in capacity of a 'leaky' condenser permanently buried in the soil should serve this purpose." A description of the method follows.

837. PREPARATION OF SOIL SAMPLES FOR MECHANICAL ANALYSIS. By I. C. Dragan. (*Landwirtschaftliche Jahrbucher*, Berlin, 1931. Abstr. from *Int. Rev. of Agr.*, Rome, xxiii., **1**, 1932, p. T4.) An exhaustive comparative study of the different methods used in this important preliminary treatment of soils for mechanical analysis.

838. STUDIES IN SOIL COLLOIDS, I.-V. By A. N. Puri (*India. Dpt. Agr. Mem., Chem. Ser.*, **11**, 1930, Nos. 1, 2, 6, 7 and 8. Abstr. from *Exp. Sta. Rec.*, 66, **1**, 1932, p. 14.) The five papers cover phases of the chemical and physico-chemical behaviour of soil colloids, their determination as a whole in soils, and the measurement of certain of their physical and chemical properties.

839. APPARATUS FOR PERCOLATION AT A UNIFORM RATE AND AUTOMATIC COLLECTING DEVICE. By P. L. Hibbard. (*Indus. and Eng. Chem. Analyt.*, Ed. 2, No. 4, 1930. Abstr. from *Exp. Sta. Rec.*, 66, **3**, 1932, p. 203.) A detailed description is accompanied by a diagram.

840. THE ALCOHOL METHOD FOR DETERMINING MOISTURE CONTENT OF SOILS. By G. Bouyoucos. (*Soil. Sci*, 32, **3**, 1931, p. 173. Abstr. from *Exp. Sta. Rec.*, 66, **3**, 1932, p. 204.) Investigations show that if the method is properly used it is accurate and reliable, and the moisture content of light-textured soils

can be determined in 5 minutes, and of the heaviest clays in about 12 minutes. A new feature is introduced whereby the soils are dispersed mechanically by means of the milk-shaking machine. By tying a spring to the paddle of the stirring rod, even the heaviest clay can be reduced to the particle state in a few minutes.

341. THE EFFECT OF DRYING AND ULTRA-VIOLET LIGHT ON SOILS. By A. E. Mortenson and F. L. Duley. (*Soil Sci.*, 32, **3**, 1932, p. 195. Abstr. in *Exp. Sta. Rec.*, 66, **2**, 1932, p. 117.) The effects of ultra-violet light were studied upon bacterial activity, the content of water-soluble calcium, the rate of settling of the colloidal material, and the growth of the plants.

342. ANALYSES OF COMMERCIAL FERTILIZERS, SEASON 1930-31. By R. N. Brackett and D. H. Henry. (*S. Car. Sta. Bull.* 276, 1931. Abstr. from *Exp. Sta. Rec.*, 66, **1**, 1932, p. 18.) The usual analyses and related data are reported.

343. A SIMPLE ELECTRODIALYSIS CELL FOR THE ROUTINE DETERMINATION OF EXCHANGEABLE BASES IN SOILS. By M. L. M. Salgado and G. W. Chapman. (*Soil Sci.*, 32, **3**, 1931, p. 199. Abstr. from *Exp. Sta. Rec.*, 66, **3**, 1932, p. 204.) Describes a simple, easily constructed, and cheap two-compartment continuous-flow type of electrodialysis cell, well suited for routine determination of the exchangeable bases of soils.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

344. SOURCE AND CARE OF COTTON PLANTING SEED IN RELATION TO THE LENGTH OF STAPLE. By J. H. Moore and J. A. Shanklin. (*N. Car. Sta. Tech. Bull.* 42, 1931. Abstr. from *Exp. Sta. Rec.*, 66, **4**, 1932, p. 327.) Comparison of cotton grade and staple estimates for the United States and North Carolina for the 1928, 1929, and 1930 crops indicated that the staple of the United States had shown no improvement, but that the staple had improved considerably in North Carolina. This improvement was probably largely due to the planting of seed from improved varieties which usually produced a staple of from $\frac{15}{16}$ to $1\frac{1}{16}$ in.

345. AN APPARATUS FOR GROWING PLANTS UNDER CONTROLLED ENVIRONMENTAL CONDITIONS. By R. A. Steinberg. (Abstr. from *J. Agr. Res.*, 43, **12**, 1931, p. 1071.) An installation suitable for accurately determining the response of plants to changes in their environment is briefly described. It comprises eight light cases for growing plants; a modified hot-blast heating system, with air washer controlled pneumatically, for regulating the temperature, humidity, and air velocity; an automatic watering system to maintain constant soil moisture and record transpiration; and a programme instrument for turning the lamps on and off automatically. The lighting units (water-cooled lamps) consist of tungsten lamps in special bulbs for burning when immersed in water. It provides for control of the day length to within a total error of ±10 seconds per month, of light intensity to within a total error of less than ±10 per cent. according to the duration of lamp burn, of light quality to within a colour-temperature variation of ±100° K., of temperature to within an error of ±0·5° F., of humidity to within an error of ±0·5 per cent., of air velocity to within an error of ±5 per cent., and of soil moisture to within an error of ±1 per cent. Each light case has a cross-section of about $2\frac{3}{4}$ square feet, and will accommodate plants 4 feet in height. Included in this description is a method for increased accuracy of pneumatic humidity control and an improved lighting unit which is also suitable for conducting experiments with coloured light. Agreement in the results of different experiments with this equipment and between these and results obtained outdoors, is generally well within an error of 10 per cent., and probably is susceptible of further improvement.

346. COTTON PLANT: VEGETATIVE PROPAGATION. By K. Vysozky. (*Textilberichte*, **13**, 1932, p. 33. Abstr. from *Summ. of Curr. Lit.*, xii., **5**, 1932, p. 121.) Experiments planned at the Turkestan Selection Station in the summer of 1930 show that the genus Gossypium lends itself to artificial vegetative propagation. Not only cuttings, but sections of leaves take root in a glass-covered hot-bed and give rise to new plants. Plates show instances of artificial propagation. In the case of a leaf cut through the petiole, the cut surface had thickened after 6 days and the leaf had put out roots after 13 days. In the case of a cutting, the cut surface had increased in size in 3 days, thickened in 7 days, and commenced to develop roots. This type of propagation will be of great importance where, for example with hybrids, it is sought to avoid further cleavage of the nearest bastard generations.

347. CALLUSING OF COTTON STEM CUTTINGS. By H. E. Rea. (*Plant Physiol.*, 5, **4**, 1930, p. 575. Abstr. from *Exp. Sta. Rec.*, 65, **9**, 1931, p. 817.) The use of soft wood, aqueous solutions of potassium permanganate, and low temperature, reduced the percentage of callusing. The storage of cuttings for brief periods, the manner of cutting, and the number of cuttings in the propagator, all had little influence on results. The highest percentage of callusing was secured with mature wood, exposure of the base of the cutting above the soil medium, the use of Houston black clay as a rooting medium, and a high temperature (20·2° C.).

348. SEED DISINFECTANT. By J. Guillissen and Union Chim. Belge Soc. Anon. (Brussels. E.P., 357,443 of 18/12/30. Abstr. from *J. of Text. Inst.*, xxii., **12**, 1931, A582.) The fungicidal effect of insoluble copper salts in the dry state, particularly of the basic carbonate, is increased by the addition of alkaline fluosilicate, particularly sodium fluosilicate.

349. NEW COTTON HARVESTER. (*Text. Rec.*, xlix., **588**, 1932, p. 81.) According to the *Econ. Rev. of the Sov. Union*, a new cotton harvester has been built which will fit the type of tractor made by the Stalingrad plant, and will harvest from 15 to 17½ acres a day.

350. ON THE VARIATION OF THE OXYGEN CONTENT OF CULTURAL SOLUTIONS. By W. A. Cannon. (*Science*, **75**, January 22, 1932, p. 108.) Cotton is one of the plants experimented upon. It has already been found that there may be translocation of oxygen from the shoot to the root when the former is in sun, the root in soil; and now it appears also to be the case when the latter is in a cultural solution, and particularly in distilled water.

351. COTTONSEED DEFIBRATING APPARATUS. By A. G. Murdoch and Br. Cottonseed Products Ltd. (London. E.P. 356,877 of 18/7/30. Abstr. from *J. of Text. Inst.*, xxiii., **1**, 1932, A14). In apparatus for defibrating cotton or other fibre-bearing seeds, of the type comprising an annular zone down which the fibre-bearing seed is passed by gravity, defibrating elements rotating in it and a current of air being passed upwards through it, two or more annular internally-projecting portions, having conical or bevelled surfaces with which the defibrating elements co-operate, are provided in spaced positions on the internal surface of the chamber. The members are integral with or separate from the chamber, and are axially adjustable. Air may be supplied to the interior of the members and pass through perforations on the conical surfaces.

[*Cf.* Abstr. **158** of this volume.]

352. COTTON GIN. By L. Mellersh-Jackson. (London, Volkart Geb., Winterthur, Switzerland. E.P. 362,446 of 26/8/1930. Abstr. from *Summ. of Curr.*

Lit., xii., **6**, 1932, p. 156.) The double roller gin of E.P. 276,879 is modified in that the shaft of each leather roller is mounted by means of journals having ball-shaped portions in bearing sleeves, which are mounted in swinging arms and connected with the shaft by loosely inter-engaging coupling members which provide clearance for radial movement.

353. GINNING: INFLUENCE ON SPINNING QUALITY. By H. H. Willis. (*Cotton.*, U.S., **96**, 1932, p. 29. Abstr. from *Summ. of Curr. Lit*, xii., **6**, 1932, p. 155.) A general discussion of the conditions contributing to poor ginning and of the effect of improper ginning on the grade, staple, and spinning quality of the cotton, and the strength, uniformity, and appearance of yarns and fabrics.

354. LES DÉRIVES DE L'INDUSTRIE DU COTON DANS L'ALIMENTATION DU BÉTAIL. TOURTEAUX ET FARINES DE COTON. By E. Letard and F. Heim de Balsac. (*Coton et Cult. Coton.*, vi, **3**, 1931, p. 161) A continuation of a previous article (*cf.* Abstr. **160**, Vol IX). Deals mainly with the use of cottonseed cake as a cattle feed, and states the quantity that can be given without injury

355. THE DIGESTIBILITY OF COTTONSEED MEAL AS A SUPPLEMENTAL FEED FOR RANGE CATTLE IN NEW MEXICO. By W. E. Watkins. (*New Mexico Sta. Bull.* 194, 1931. Abstr from *Exp Sta. Rec.*, **65**, 8, 1931, p. 760.) An effort was made to determine nitrogen balances of steers while under different maintenance and submaintenance conditions. The steers were fed individually throughout seven trials. They were brought to a losing condition and then fed different proportions of cottonseed meal with their wheat and straw. The addition of a small amount of cottonseed meal caused an increased consumption of roughage. The added proteins were almost solely responsible for the increase in total digestible nutrients in the ration, which indicated that protein was probably the most important nutrient among the total digestible nutrients. During periods four to seven inclusive, the steers retained 15·9, 28 8, 42 1 and 25·5 gm. of body protein per pound of cottonseed meal consumed. These results explain how a small amount of protein-rich supplement might prevent losses during emergencies, as 0·5 lb. of cottonseed meal was quite sufficient for starting animals to gain in body protein and in live weight.

356. COTTONSEED OIL: COMPOSITION. By W. Weiss. (*Dissertation*, Dresden, 1931, p. 43. Abstr. from *Summ. of Curr. Lit*, xii., **6**, 1932, p. 185.) The most recent methods for separating fatty acids have been used in an examination of cottonseed oil. The sample consisted of glycerol 5·2 per cent, unsaponifiable matter (phytosterols, etc.,) 0·7 per cent., and fatty acids 94·8 per cent., comprising linolic 30·7 per cent., oleic 49·3 per cent., myristic 0·06 per cent., palmitic 18.8 per cent., stearic 0·9 per cent., and arachic 0·05 per cent.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

357. PFLANZENSCHUTZ PRAKTIKUM. A Practical Handbook on Plant Protection. By E. Riehm. (Berlin, Paul Parey, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **2**, 1932, p. 74.) This booklet is intended primarily for students of agriculture and forestry, but is of interest to all concerned with plant protection work against insect, fungous and vertebrate pests. Chemical, biological and mechanical control measures are surveyed, with details and illustrations of the necessary apparatus for testing and applying the materials used.

358. SUR GRADATIONSLEHRE. Contribution to the Theory of the Rate of Increase. By E. Martini. (*Verh. deuts. Ges. angew. Ent.* 8 *Mitgliederversamml. Rostock*, **1930**. Berlin, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **2**, 1932, p. 75.) A general discussion of the factors affecting the distribution and increase of insects.

359. Quarantine Measures against Foreign Cotton Pests in the United States of America and other Countries. By V. V. Nikolskii. (In Russian.) (*Plant Prot.*, vii., 1-3, 1930, p. 139. Abstr. from *Rev. App. Ent.*, xx., Ser. A., 2, 1932, p. 91.) The present state of cotton cultivation in the world is briefly reviewed, and emphasis is laid on the importance of insect pests, which cause enormous losses to the crop. The three chief pests, *Anthonomus grandis*, *Platyedra gossypiella*, and *Earias insulana*, are dealt with separately, their history, geographical distribution and biology, and the losses they cause being discussed. A brief account is given of the organisation and activities of the Federal Horticultural Board, by means of which quarantine regulations against cotton pests are enforced in the United States, and of the campaign against the spread of *P. gossypiella*. Other cotton-producing countries in which legislation against cotton pests has been passed are also dealt with, and brief notes on their quarantine measures are given.

360. Cotton Pests in the Punjab. By M. A. Husain. (*Ann. Rpt. of Entomologist to Govt. Punjab*, 1930. Abstr. from *Rev. App. Ent.*, xx., 2, 1932, p. 100.) Parasites of *Earias* spp. reared from various stages of the moths collected in cotton fields included *Melcha nursei*, Cam., from the cocoons. Studies on the effect of temperature on the development of *Platyedra gossypiella* show that when placed in incubators in January at 15° C. (59° F.) the larvæ hibernate and do not pupate, at 20° C. (68° F.) emergence chiefly occurs during April and May, at 25° C. (77° F.) it starts a little earlier and continues till the end of July, and at 30° C. (86° F.) the moths begin to appear much earlier, maximum emergence being over before May. The optimum temperatures for oviposition were found to be 20-25° C., females laying as many as seventy-six eggs each. Further studies on the bionomics of *Bemisia gossypiperda* showed that twelve generations may occur in a year. At the beginning of the season parasitism did not exceed 2·5 per cent. By September, however, it had risen to 33·8 per cent., again dropping to a low percentage with the approach of winter.

361. Work with Economic Insects at the Texas Station. (*Texas Sta. Rep.*, 1930. Abstr. from *Exp. Sta. Rec.*, 66, 1, 1932, p. 49.) A study of the cotton flea hopper by Reinhard and Thomas failed to show any nymphs to be distributed by the wind, although many adults thus carried were captured by means of screens and nets. Fewer cotton flea hoppers were found by Reinhard and Gaines to emerge from over-wintering eggs on croton weeds during the spring of 1930 than any year since 1926, when the hibernation records were first kept. The effective mean minimum temperatures during February and March were sufficient to cause practically 37 per cent. of the hoppers to emerge before cotton was up to a stand in the field. Although approximately 58 per cent. of the total emergence of the hoppers occurred during April, the numbers were insufficient to produce any severe or widespread damage to the crop. A summary is given in tabular form of all available hopper emergence records from 1926 through April, 1930.

Preliminary work on the hibernation of the pink bollworm by F. A. Fenton and W. L. Owen, Jr., in co-operation with the U.S.D.A. Bureau of Entomology, conducted at Presidio during the winter of 1928-29, is reported upon. They found that in adobe soil, where by far the greater emergence took place, it increased daily throughout April and reached its peak May 11; then there was a rapid decline until June 15, after which date a few late moths emerged up to August 14. In sandy soil the emergence reached its peak April 27, and the last moth emerged June 16. Boll infestation by this pest appeared a month earlier in 1929 than in the preceding year, and was the heaviest observed since 1925, when the records were first kept. At Castolon, where a non-cotton zone had been maintained in 1928, the first infestation was observed by the middle of September, 1929. The longevity of the moths was greatly influenced by temperature, the threshold of activity appearing to be around 60° F. The maximum fecundity noticed was 323 eggs. The developmental zero for the eggs was about 58·4° F. In the field cages the period from the egg of one generation to that of the following averaged 30 days. The combination of ploughing immediately followed by irrigation gave the greatest kill, regardless of when these operations were carried out, provided the irrigation was done within a few days after the ploughing. The attempted introduction of the parasite *Microbracon kirkpatricki* from the Sudan failed, due to the inability to rear the adults.

In control work with the cotton bollworm, F. L. Thomas found that where calcium arsenate was used an average yield of 1,135 lb. of seed-cotton per acre was obtained, as compared with 135 lb. per acre in plats where no dust was applied. Eight applications in all were made, the first five being responsible for about 900 lb. of the increase in yield.

362. Report of Work in Entomology at the Tennessee Station. By S. Marcovitch. (*Tenn. Sta. Rpt.*, 1930, p. 35. Abstr. from *Exp. Sta. Rec.*, 65, **9**, 1931, p. 850.) In light trap-work with cutworm moths, 63 additional species were captured during the year, bringing the total up to 218 species of Noctuidæ occurring in the State.

363. Insect Pests of Cotton. By E. F. Grossman. (*Press Bull.* 441, Flor. Agr. Exp. Sta., 1932.) Deals briefly with control measures for aphids, army worm, cotton leafworm, corn earworm, red spider, stainers, cutworms, and cotton flea hopper.

364. Epidemiology of Insect Pests. (*Nature*, Vol. 129, No. 3,251, 1932, p. 260.) A review by Dr. B. P. Uvarov of *Die Forstinsekten Mitteleuropas: ein Lehr- und Handbuch* (K. Escherich). After introductory remarks on the changes that have come over economic entomology in recent times, so that it has become to a great extent an epidemiology of insect pests, Dr. Uvarov goes on to say: "The book under review hides under its unpretentious title a masterly presentation of this new aspect of economic entomology. The methods and results of epidemiological research are discussed in its general part, while the special part contains a wealth of facts, all arranged according to the epidemiological conception of entomology. The chapter on the Pine Moth (*Panolis flammea*, L.) can be recommended for reading to every biologist interested in general evolutionary problems, because this pest has been recently studied epidemiologically by a number of outstanding entomologists, and the results, summarized by the author in a very concise way, represent a unique picture of the life of a species as a whole, and in the actual, enormously complex environment."

365. Determination of the Winter Survival of the Cotton Boll Weevil by Field Counts. By E. F. Grossman and P. W. Calhoun. (*Bull.* 233, Flor. Agr. Exp. Sta., 1931.) A comparison of hibernation cage experiments and field-count experiments for determining the winter survival of the boll weevil, carried out over five years.

366. Hibernation of the Cotton Boll Weevil under Controlled Temperature and Humidity. By E. F. Grossman. (*Bull.* 240, Flor. Agr. Exp. Sta., 1931.) A study of the effects of temperature and humidity on the boll weevil, in which uniform temperatures and relative humidity were maintained in artificial hibernation quarters in which boll weevils were placed.

367. Methods for making Counts of Boll Weevil Infestation. By E. F. Grossman. (*Bull.* 241, Flor. Agr. Exp. Sta., 1931.) Describes a new

method of making infestation counts, and also the Point method and the Survey method.

368. A CORRELATION OF THE DATE OF EMERGENCE AND PERCENTAGE OF SURVIVAL OF THE COTTON BOLL WEEVIL WITH THE DATE OF THEIR INSTALLATION IN HIBERNATION CAGES. By P. W. Calhoun. (*Flor. Ent.*, xv., **3**, 1931, p. 41. Abstr. in *Rev. App. Ent.*, xx., Ser. A., **3**, 1932, p. 179.)

369. THE PINK BOLLWORM OF COTTON IN PORTO RICO. By M. D. Leonard. (Reprinted from *J. of Dpt. of Agr., Porto Rico*, xvi., **1**, 1932, p. 65.) The introduction, spread and present status of the pink bollworm, *Pectinophora gossypiella*, Saunders, in Porto Rico, are described. In order to understand the somewhat unusual conditions under which the insect is working in the island, the essential climatic and topographic features and the development of Sea Island cotton-growing in Porto Rico are briefly outlined. Attempts at control are discussed, together with the relation of alternate host plants as a factor in carry-over of the insect from one crop to another.

370. HIBERNATION OF *Pectinophora Gossypiella* IN TEXAS. By F. A. Fenton and W. L. Owen. (*J. of Econ. Ent.*, xxiv., **6**, 1931, p. 1197.) The results of three years' studies on the hibernation of the pink bollworm are presented. It was found that in the cotton field the greatest number of the over-wintering stages were in bolls on the stalks, although a considerable number were in shed forms or cocoons in trash on the surface of the ground. A comparatively small number were in the soil. Averages for three years show that the final survival in bolls buried 4 inches but not irrigated was greater than in bolls on the surface of the soil when not irrigated, though this ratio was reversed in sandy loam soil or when bolls were buried in the month of March. An irrigation of surface bolls increased the survival. March burial of 4 inches produced greater mortality than December burial at the same depth, without irrigation in either case. Immediate irrigation of bolls buried 4 inches caused much greater mortality under certain conditions than occurred in bolls buried the same depth but not irrigated, but 3-year averages under such irrigation in all soil types studied and for all months show very little difference. Delaying irrigation three months after burial greatly increased survival over that in bolls buried 4 inches but not irrigated, or in bolls buried 4 inches and irrigated at once. The survival in bolls in sandy loam was much lower than in bolls in silty clay soil.

371. THE PINK BOLLWORM IN THE VIRGIN ISLANDS. By M. S. Baker. (*Virgin Islands Sta. Rpt.*, 1930, p. 14. Abstr. from *Exp. Sta. Rec.*, 65, **8**, 1931, p. 758.) Pink bollworm larvæ were found in the first blooms that opened, and about 15 per cent. of the cotton bolls were infested. It is pointed out that the seed had been treated with sulphuric acid before planting. In an effort to check the ravages of the pink bollworm, one plat of five rows of Sea Island cotton was sprayed at regular intervals with Bordeaux mixture in which lead arsenate had been incorporated, this plat yielding 159·9 lb. more of seed-cotton per acre than did the untreated. Paradichlorobenzene in kerosene was poured about the roots of the cotton plants without injury, the odour being noticeable for 60 days after the application.

372. LA VER ROSE DU COTON, *Gelechia* (*Platyedra*) *Gossypiella*, S. (*Bull. Agr. Congo belge*, xxii., **2**, 1931, p. 168. Abstr. from *Rev. App. Ent.*, Ser. A., xx., **2**, 1932, p. 70.) Since its introduction in 1927 this pest has become more widely distributed, and is now present in several of the northern districts. A short account is given of the injury caused, and the adult and larva are compared with those of *Pyroderces simplex*, and *Diparopsis castanea*, with which it might be confused.

373. *Lasioderma serricorne*, F., ALS SCHÄDLING AN BAUMWOLLSAMEN. (*L. serricorne* as a Pest of Cotton Seeds.) By J. Wille. (*Anz. Schädlingsk.*, vii., 10, 1931, p. 110. Abstr. from *Rev. App. Ent.*, xx., 1, 1932, p. 6.) The tobacco beetle, *Lasioderma serricorne*, F., was found in January, 1930, in an oil factory in Peru, breeding in cotton seeds that had previously been damaged mechanically during harvesting, or attacked by fungi or other insects. Further observations showed that the beetle was also present in numbers in cotton fields infesting the so-called "cocopa" bolls—*i.e.*, those that have the fibre joined together and stained as a result of unfavourable weather, badly timed irrigation, or infestation by the Pyralid, *Mescinia peruella*, Schaus., or by *Dysdercus ruficollis*, L. When the cotton is collected, some of the fibre in these bolls usually remains on the plants, eventually dropping to the ground, and is attacked by *Lasioderma*. As the number of cocopa bolls left in the field gradually increases towards the end of the harvest season, the infestation reaches its maximum in July. In Peru, *L. serricorne* has five generations between September and April inclusive, and one or two in the winter months (May-August). Eggs are deposited on the partly or completely dry walls of the bolls, or on the compressed fibre, should it be exposed; the larvæ at first feed on the fibres or the shrivelled boll and then bore into the seeds, of which each larva damages several, and with which they are carried into the storerooms. Pupation occurs inside the seeds or at the bottom of the boll in an oval cell filled with frass. Though *L. serricorne* only attacks damaged bolls, it is of considerable importance, owing to the injury caused to the cocopa cotton and the depreciation of its market value. For control in the field, clean cultivation is recommended. In districts where the growing of perennial cotton has been abandoned, a marked decrease in the numbers of *L. serricorne* and the attacked cocopa bolls occurred; moreover, the practice of replanting every year would also be of great value for the control of such pests as *Gasterocercodes gossypii*, *D. ruficollis* *M. peruella*, and *Anthonomus vestitus*.

374. COTTON CRICKET PEST: CONTROL. By J. W. Folsom. (*Chem. Abs.*, 25, 5951, 1931. Abstr. from *Summ. of Curr. Lit.*, xii., 3, 1932, p. 59.) Calcium arsenate and a mixture with Paris green, when dusted on cotton fields, decreased the number of field crickets (*Gryllus assimilis*, var. *pennsylvanicus*). A poison bran bait containing Paris green was also very effective.

375. A TACHINID FLY BRED FROM THE PUPÆ OF *Laphygma exigua*, HUBN.: A COTTON PEST IN TURKMENIA. By B. B. Rodordorf. (In Russian, with summary in German.) (*Plant Prot.*, viii., 1, 1931. Abstr. from *Rev. App. Ent.*, Ser. A., xx., 3, 1932, p. 147.) A detailed description of the Tachinid, *Prosopœa deserticola*, sp. n., reared in July, 1930, from pupæ of *Laphygma exigua*, at Merv, south-eastern Turkmenistan.

376. INSECT ENEMIES OF THE CORN EARWORM (*Heliothis obsoleta*, FABR.). By T. F. Winburn and R. H. Painter. (*J. Kansas Ent. Soc.*, v., 1, 1932, p. 176. Abstr. from *Rev. App. Ent.*, xx., Ser. A., 3, 1932, p. 176.) A list is given of 82 insect enemies of *Heliothis obsoleta*, F., in various parts of the world, based on a survey of the literature, of which 46 are Hymenoptera and 22 Diptera.

377. THE BIOLOGY OF *Erythroneura* (*Zygina*) *Pallidifrons*, EDWARDS. By E. I. MacGill. (Reprinted from *Bull. of Ent. Res.*, xxiii., 1, 1932, p. 33.) In view of the importance of leaf-hoppers, or jassids, as pests of cotton in Africa, it was suggested to the author that further knowledge of these insects was desirable, and it was decided to use the common species infesting glasshouses in this country as a type for investigation with cotton as a food-plant. Four blocks of cotton seed (American Upland), each block containing 20 plants in 12-in. pots, were sown: two, A and B, on March 27, and two, X and Y, on May 8. A, X and

Y all received 1,000 c.c. of water a week, while B only received 500 c.c. The soil in the pots belonging to A, B, and Y was left untouched, but the soil in X was tilled after each watering. The number of nymphs present on 20 leaves in each block were counted at seven-day intervals. Infestation counts on blocks A and B began on May 5, when the cotton plants were about 5 weeks old. Counts on X and Y began on June 23. The mean infestation factors for the four blocks for the period of the experiments (about 24 weeks) were as follows: A, 5·5 nymphs to 20 leaves; B, 3·0; X, 1·8; Y, 1·8. Block A, planted in March and receiving 1,000 c.c. of water a week, has a definitely higher infestation factor than B, also planted in March, but only receiving 500 c.c. a week. Both blocks show a much higher degree of infestation than the plants sown in May. The infestation of X and Y is the same, so that tilling the soil appears to have no effect, either adverse or favourable, on the infestation of the plant by *E. pallidifrons.*

378. SOME BIRD ENEMIES OF THE DESERT LOCUST (*Schistocerca gregaria*, F.) IN THE AMBALA DISTRICT, PUNJAB. By M. A. Husain and H. R. Bhalla. (*Ind. Jour. of Agr. Sci.*, i., **5**, 1931, p. 609.) Among the birds mentioned as feeding on locusts were crows, guinea-fowl, swans, and storks.

379. SUR L'HABITAT DE *Schistocerca gregaria*, FORSK., ET LA SUCCESSION DES GÉNÉRATIONS CHEZ CETTE ESPÈCE. By P. Regnier *et al.* (*C. R. Acad. Sci. Fr.*, cxcii., **23**, 1931, p. 1485. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **10**, 1931, p. 599.) In African territories west of the meridian of Greenwich, the distribution of *S. gregaria*, Forsk., is limited in the South by 12° N. Lat.; between this parallel and 21° N. Lat. it occurs together with *Locusta migratoria migratorioides*, R. and F., and *Anacridium mœstum*, Serv.

According to reports on breeding in the autumn and winter of 1930, received from different parts of French West Africa, and on breeding experiments in the summer and winter, it appears that the annual cycle of *S. gregaria* (phases *gregaria*, *congregans*, and *dissocians*) in West Africa consists of a summer and a winter generation, the latter occupying a longer period and including a diapause in the adult stage. In Morocco the migration of the summer generation is from north to south, and of the winter one in the reverse direction.

380. QUELQUES OBSERVATIONS SUR LES ACRIDIENS MIGRATEURS. By P. Vayssière. (*C. R. Acad. Sci. Fr.*, cxciii., **5**, 1931, p. 294. Abstr. from *Rev. App. Ent.*, xix., Ser. A., **11**, 1931, p. 643.) The author states that the distribution of *Schistocerca gregaria*, Forsk., in West Africa is not limited in the south by 12° N. Lat. (*cf.* previous abstract), and gives particulars of specimens from areas in French West Africa on and south of that parallel. Moreover, in the spring of 1930, swarms of immature *S. gregaria* were observed in the northern Belgian Congo, flying towards Uganda. Thus, the true southern limit is apparently constituted by the equatorial forest.

The outbreak of *Locusta migratoria migratorioides*, R. and F., which in the winter of 1930 caused considerable damage to *Eleusine*, Sorghum, and maize in Oubangui-Chari, assumed disastrous proportions in Kamerun, the Ivory Coast, and French Guinea in 1931; in French Guinea two-thirds of the banana crop were destroyed. The multiplication of this locust appears to be favoured by bush fires, which produce ideal conditions for oviposition. In many localities the French West Africa mixed swarms of *Schistocerca* and *Locusta* have been recorded.

381. ON THE OCCURRENCE IN THE SUDAN OF *Locusta migratorioides*, R. AND F., AND ITS ASSOCIATED PHASES. By H. B. Johnston and R. C. Maxwell-Darling. (*Bull. Ent. Res.*, xxii., **3**, 1931, p. 399. Abstr. from *Rev. App. Ent.*, Ser. A., xix., 12, 1931, p. 710.) Hoppers and adults of all phases are described, and measurements of them given.

382. PARASITES AND HYPER-PARASITES OF THE EGG-PODS OF INJURIOUS LOCUSTS (ACRIDODEA) OF TURKESTAN. By A. A. Jazykov. (*Bull. Ent. Res.*, xxii., 3, 1931, p. 385. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., 12, 1931, p. 711.) A summary of part of an extensive Russian report on parasites of the egg-pods of nine injurious species of locusts in Turkestan studied in 1927-30. In some cases notes are given on the bionomics of the parasites, and a list of the species of locusts with their respective parasites is included.

383. ON THE RECENT SWARMING OF *Locusta migratorioides*, R. and F. By O. B. Lean. (*Bull. Ent. Res.*, xxii., 3, 1931, p. 365. Abstr. from *Rev. App. Ent.*, xix., Ser. A., 12, 1931, p. 709.) Outlines the history of the recent outbreak of *Locusta migratoria migratorioides*, R. and F., in Africa. The locust appears to have two breeding seasons a year. The first commences with the first rains and the second towards the end of the wet season, the adults appearing after the last rains. The adult generation living during the dry season lasts for a longer time, so that this apparently causes an adult diapause. The adult locusts feed almost entirely on graminaceous plants, principally maize, sorghum, rice, and sugar-cane. During the dry season they occasionally attack coconut, oil palms, banana, pineapple, sisal, etc., in search of water rather than of food. The diet of the hoppers is similar; they also occasionally feed on groundnuts.

A brief summary of previous outbreaks in Africa is included.

384. INFORMATION ON THE LAST ANTI-LOCUST CAMPAIGN: ALGERIA. By M. Delassus. (*Int. Rev. Agric.*, xxii., 6, 1931. Abstr. from *Rev. App. Ent.*, xix., Ser. A., 11, 1931, p. 683.) A poison-bait of 4-5 lb. sodium arsenate, 10 lb. molasses and 100-120 lb. bran was successful in controlling hoppers of *Schistocerca gregaria* when they were 3-4 days old. A new flame-thrower is described,which has met with some success, but is more expensive than poison bait. The egg-clusters were sought for by numerous birds, especially larks. Adult locusts were attacked by the flies *Sarcophila latifrons*, Fall., *Disjunctio* (*Wohlfahrtia*) *bella*, Macq., and *Phaonia trimaculata*, Bch. The eggs were destroyed by the fungus *Oospora ovorum*, and by larvæ of *Phorbia* (*Chortophila*) *cilicrura*, Rond, and *Stomatorrhina lunata*, F. The latter, in one locality, destroyed 90-95 per cent. of the eggs.

385. RAPPORT DE LA RÉUNION INTERNATIONALE CONVOQUÉE PAR LE MINISTRE DES COLONIES D'ITALIE POUR L'ÉTUDE DU PROBLÈME DES ACRIDIENS MIGRATEURS. (Rome, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A., 3, 1932, p. 160.) The report of a meeting of experts organized by the Italian Government at the suggestion of the British Government, to discuss methods for co-ordinating studies on migratory locusts in Africa and Western Asia.

386. LOCUST INVASIONS. By A. J. Brooks. (*Ann. Rpt. Dpt. Agr., Gambia*, 1930-31. Abstr. from *Rev. App. Ent.*, xx., Ser. A., 1, 1932, p. 9.) Deals with locust invasions in Gambia and control measures adopted.

387. THE EFFECT OF CLIMATE ON THE MIGRATIONS AND BREEDING OF *Locusta migratorioides* IN NIGERIA. By O. B. Lean. (*Bull. Ent. Res.*, xxii., 4, 1931, p. 551. Abstr. from *Rev. App. Ent.*, xx., Ser. A., 2, 1932, p. 97.) An attempt to correlate the main movements and breeding seasons of locusts in Nigeria with the seasonal climatic changes from December 1929 to April 1931.

388. THE PALESTINE LOCUST CAMPAIGN, 1930. By G. E. Bodkin. (Jerusalem, 1931. Abstr. in *Rev. App. Ent.*, xx., Ser. A., 3, 1932, p. 158.)

389. KENYA: REPORT ON THE 1931 LOCUST INVASION. (*Bull. No.* 21, Dpt. of Agr., Kenya, 1931.) Gives the results of the following methods of control used in the campaign against locusts: trapping, spraying with arsenite of soda, poison baits, flame-throwers, smudge fires, smoke screens.

890. *Alternaria gossypina* (THÜM.), COMB. NOV., CAUSING A LEAF SPOT AND BOLL ROT OF COTTON. By J. C. F. Hopkins. (Reprinted from *Trans. Brit. Mycol. Soc.*, xvi., Pts. II. and III., December, 1931.) A discussion of a common leaf spot of cotton in Rhodesia attributed to *Alternaria gossypina* (Thüm.), comb. nov., which is also found associated with a rot of bolls. Symptoms of the disease on leaves and bolls are described. Details are given of inoculation experiments on both bolls and leaves by which the disease was produced on growing plants. Microscopic characters of the fungus are compared with those of *Alternaria macrospora*, causing a similar disease in Nigeria and Trinidad, and certain cultural phenomena are noted. Reasons are given for referring the Rhodesian fungus to *Alternaria gossypina* (Thum.), comb. nov.

891. THE VALUE OF SEROLOGICAL TESTS FOR THE IDENTIFICATION OF *Pseudomonas* (*bacterium*) *malvacearum*. By E. S. Horgan. (*J. of Bact.* xxii., **4**, 1931, p. 287. Abstr. from *Rev. App. Mycol.*, xi., **3**, 1932, p. 176.) The results of tests (which are tabulated and briefly discussed), to determine the specificity of the agglutination test in the identification of this organism, showed that both floccular and granular or somatic agglutinins were present in all the sera prepared against four strains of *Bacterium malvacearum*. The so-called "rough" strain X5 (from Shambat lint) gave a perfect emulsion without a trace of the "R" agglutinin, but a tendency to the formation of granular colonies was observed. Absorption was found to be completely reciprocal, any one strain removing all agglutinins from a given serum, both for itself and for all other strains.

892. LA "FRISOLÉE" DU COTONNIER. By W. J. Lugard. (*Agr. et Elev. au Congo belge.* March 19, 1932.) A description of the symptoms of "leaf curl" (frisolée) and of "leaf roll" which occurs in Nigeria and the Anglo-Egyptian Sudan. It is doubtful whether the frisolée encountered in the Belgian Congo and in Oubangui-Chari (A.E.F.) is due entirely to the same causal agent as that in Nigeria and the Sudan. Certain symptoms characteristic of the frisolée in Nigeria and the Sudan are absent in the infested plants of the Belgian Congo and of Oubangui-Chari. It is possible that the disease in the Belgian Congo and Oubangui-Chari is due to a combination of different malformations. The view is expressed that the malformations met with in the forest regions are principally due to the same causal agent as that which causes "leaf-curl" in Nigeria and the Sudan, but that the growth deformations noticeable in Oubangui-Chari are caused by the impermeability of the subsoil, and the difficulty encountered by the cotton plant in forming a normal root system.

893. THE USE OF SULPHUR IN THE CONTROL OF RED-LEAF BLIGHT. By G. L. Kottur and S. S. Marallhalli. (*Agr. and Livestock in India*, i., **6**, 1931, p. 638.) Sulphur dusting has proved very successful in controlling the red-leaf blight of American cottons at Dharwar. Although the number of dustings and the quantity of sulphur used in each dusting was more than was necessary, the plants did not suffer in any way. The shedding of leaves and flowers reported by Thakar and Desai (1929) was not observed. To ascertain whether American cottons had any advantage in this respect over Indian varieties, dusting was done on the local Kumpta cotton in December when the cotton was in full flower. Four days after the flowers began to shed. This was followed by the shedding of almost all the primary leaves. The shedding of buds and flowers continued for about a week, after which the plants recovered and began to put forth new buds. This shows that Indian cottons are affected by sulphur-dusting, especially when dusting is done during the flowering period. No such effect was noticed in the case of

American cotton. Sulphur is becoming a general remedy for many insects and fungoid pests, but in some cases the effects are harmful. The fact that sulphur checks the red-leaf blight, and at the same time has no injurious effect, is of great value to all growers of American cotton in the country.

394. DIE JUGENDKRANKHEITEN DER BAUMWOLLE IN DER TÜRKEI. By F. Forsteneichner. (*Phytopath. Zeitsch.* iii., **4**, 1931. Abstr. from *Rev. App. Mycol.*, x., **12**, 1931, p. 788.) Full details are given of the writer's investigations on the seedling diseases of cotton in the Adana region of Turkey. The following organisms were found to be involved in the causation of the sore-shin disease, viz., *Rhizoctonia gossypii* n. sp., var. *anatolica* n. var., *Rhizopus nigricans*, *Gibberella moniliformis*, *Fusarium scirpi*, and *Alternaria humicola* var. *gossypii* n. var.

Infection by the fungi discussed in this paper was found to be greatly favoured by the low mean temperature (16·9° C.) prevailing in the Adana district during the spring, the Lightning Express 2 (*Gossypium hirsutum*) being more susceptible in this respect than Jerli (*G. herbaceum*). Other factors promoting invasion by the organisms in question are the formation of a soil crust and a high degree of soil humidity.

395. REPORT ON THE FOURTH ANNUAL COTTON ROOT-ROT CONFERENCE. By W. N. Ezekiel *et al.* (*Phytopath.*, xxi., **10**, 1931. Abstr. from *Rev. App. Mycol.*, xi., **3**, 1932, p. 176.) Among other items of interest in this report on *Phymatotrichum omnivorum* in relation to cotton root-rot, the following may be mentioned: Physiologic forms differing widely in cultural characters are described (Ezekiel and Taubenhaus); additions are made to the host list of *P. omnivorum* of thirty-two non-cultivated and thirty-five ornamental species of plants (Wolff and Dana). Notes are given on the toxicity to *P. omnivorum* of various disinfectants.

396. COTTON ROOT-ROT FUNGUS: OCCURRENCE IN ARIZONA DESERTS. By C. J. King *et al.* (*Science*, **75**, 1932, p. 48. Abstr. from *Summ. of Curr. Lit.*, xii., **5**, 1932, p. 123.) Observations of extensive patches of spore mats of the root-rot fungus along the roadside in a desert area of Arizona are reported. A profuse desert vegetation existed in this area, which was about twelve miles from the nearest cultivated field, and separated from the general drainage water channels of the region. Typical strands of the fungus were found on the roots of several native plants, and some species showed evidence of definite injury by the fungus. Sclerotia were found in samples of soil from areas near the patches of spore mats. These observations seem to afford definite evidence that the fungus is indigenous in virgin lands in the south-west, and explain the occasional occurrence of the disease in the first cultivated crops that are planted after clearing the native vegetation.

397. CYCLES OF GROWTH IN COTTON ROOT-ROT AT GREENVILLE, TEXAS. By H. C. McNamara *et al.* (*U.S. Dpt. of Agr. Circ.* 173, 1931, p. 18. Abstr. from *Exp. Sta. Rec.*, 66, **2**, 1932, p. 149.) Repeated mapping of individual cotton root-rot spots during a period of several years showed all spots to pass through a cycle in which after several seasons of regular growth there abruptly occurred a very marked reduction of infection. Only a few small centres were left, and from these parts vigorous activity was resumed. No correlation was evident between weather and the phenomenon observed because quite often two adjacent spots behaved contrastingly in the same year. No definite period was associated with the breaking up, this occurring at five-year intervals in some spots and at longer intervals in others. The authors believe that breaking up of large spots indicates a weak point in the life of the fungus and offers an opportunity for the use of soil disinfectants or the planting of non-susceptible crops to carry reduction still further.

398. COTTON ROOT-ROT IN TEXAS. By J. J. Taubenhaus *et al.* (*Texas Sta. Rpt.* 1930. Abstr. from *Exp. Sta. Rec.*, 66, 1, 1932, p. 42.) The rapidity of development of cotton root-rot was shown in the case of okra plants grown on a cotton root-rot-free area and inoculated on July 2. By August 10 many of the plants had succumbed, and large numbers of new sclerotia, in turn capable of infecting cotton plants, were found in the soil.

Attempts at College Station to inoculate healthy cotton with *Phymatotrichum* spores were unsuccessful ; a small percentage of the spores germinated, but soon died. In moistened holes in the soil spore mats developed within twenty-four hours. A *Hydnum* found in close proximity to cotton or other susceptible plants dying from root-rot was suspected of being the perfect stage of the fungus, but no resemblance was found in the growth of cultures, nor was infection secured when cotton plants were inoculated with *Hydnum* sporophores. At the Temple Station it was found that root-rot spreads at the rate of from 10 to 18 ft. per year; spread was retarded when the soil temperature dropped below 70° F. Evidence from soil reaction studies at College Station indicated that it would be possible to control root-rot in soils low in lime by applying sulphur, though the methods and amounts are uncertain. The generally accepted conclusion that monocotyledonous plants are resistant to root-rot was sustained in observations on corn and cotton growing in alternate hills in heavily infested soil: the cotton alone succumbed.

399. COTTON ROOT-ROT FUNGUS: CONTROL. By D. C. Neal *et al.* (*Science*, 75, 1932, p. 139. Abstr. from *Summ. of Curr. Lit.*, xii., 5, 1932, p. 123.) Ammonia has a toxic effect on the cotton root-rot fungus, *Phymatotrichum omnivorum.* Experiments showed the growth of the fungus to be notably restricted in the presence of ammonium salts, the mycelial and sclerotial stages to be killed by short exposure to the gas, and the fungus to be killed in the tissues of cotton roots by application under field conditions of dilute ammonium hydroxide solutions. Disinfection with ammonia under field conditions appears to be more complete than with formalin or sodium hypochlorite, and the danger of killing adjacent plants, as by formalin treatments, is avoided.

400. EGYPTIAN COTTON WILT DISEASE. By A. Fikry. (*Bot. Gaz.*, **46**, 1932, p. 29. Abstr. from *Summ. of Curr. Lit.*, xii , 5, 1932, p. 123.) Investigations on the wilt disease of Egyptian cotton have led to the identification, so far, of *Fusarium orthoceras*, *F. vasinfectum*, and *F. angustum* as fungi responsible for the disease. The experiments were made under controlled environmental conditions in laboratories and glass-houses in London and Cambridge. The disease causes a brown discoloration of the fibro-vascular bundles of the roots and stems of seedlings. A characteristic yellowish appearance, called " mosaic," in the cotyledons and leaves is the first external symptom of cotton wilt under favourable conditions. The cultural characters of the three fungi were studied extensively on a variety of media, and their growth rates at different temperatures and on media of different pH values were determined. The wilt disease is widely distributed in the Delta, the reduction in yield of cotton being estimated at more than 10 per cent. of the crop.

401. COTTON WILT STUDIES. III. THE BEHAVIOUR OF CERTAIN VARIETIES GROWN ON SOIL ARTIFICIALLY INFESTED WITH THE COTTON WILT ORGANISM. By J. O. Ware *et al.* (*Bull. No.* 269, Univ. of Arkansas, 1932.) A continuation of previous studies (*cf.* Abstr. **630**, Vol. VI.). The following strains of cotton are classed as " wilt resistant ": Dixie-Triumph (Watson), Dixie-Triumph (Marett), Dixie 14, Lightning Express, Super Seven (Coker), Miller. The following are stated to be " wilt tolerant ": Arkansas Rowden 40, Arkansas 17, Arkansas Rowden 2088, D and P.L. 6, Express 121, D and P.L. 4, Cleveland 54, Arkansas Rowden 2119, Wilson Type Big Boll.

402. Further Notes on Plant Diseases in Peru. By E. V. Abbott. (*Phytopath.*, xxi., **11**, 1931, p. 1061. Abstr. from *Rev. App. Mycol.*, xi., **4**, 1932, p. 225.) Cotton wilt (*F. vasinfectum*) is rapidly becoming so serious that several plantations in the Rimac and Carabayllo Valleys have been abandoned. The American Upland varieties Rowden 40, Rowden 2119, Super Seven, Dixie Triumph, and Express, which have shown resistance to wilt in the United States, all proved more susceptible at Lima than the native Tanguis. In the coastal valleys cotton is liable to attack by *Erysiphe malachræ*, sometimes causing partial defoliations but occurring too late in the season to do much damage. *Alternaria* leaf-spot killed five acres of cotton seedlings near Lima in 1929.

[*Cf.* Abstr. **247**, Vol. VII., 1930.]

403. Plant Pathology at the Tennessee Station. By J. A. McClintock and C. Sherbakoff. (*Tenn. Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 65, **9**, 1931, p. 840.) Cotton plants affected with Verticillium wilt dropped their top leaves first, the lower branches retaining their foliage for some time and the roots remaining green for a long period, whereas in the ordinary wilt the leaves wither gradually over the whole plant, and by the time they abscind the bark near the soil and the roots are dead. No Upland variety of cotton proved resistant to this disease, although some difference was evident, giving hopeful prospects for selection work.

404. Seed Micro-organisms. By T. R. Lathe and V. Subrahmanyan. (*J. Ind. Inst. Sci.*, 14A., 1931, p. 119. Abstr. from *Summ. of Curr. Lit.*, xii., **1**, 1932, p. 16.) A study of the nature and distribution of micro-organisms associated with a large number and variety of seeds, including seeds of *Gossypium herbaceum*, has shown that the micro-organisms are all derived from the soil, and that none of them is specific to any of the seeds. Treatment with heat or antiseptics does not sterilise the seed-coat completely, but leads to the selection of one or more resistant forms which are not generally specific to the seeds from which they are isolated. There is no direct evidence that living organisms are present in healthy seeds. Sterilisation of the seed-coat does not affect either germination or development of the seedling provided the last traces of the antiseptic are removed. Addition of active cultures of specific organisms does not help germination, but may prove inimical to the growth of the seedling under certain adverse conditions. The presence of micro-organisms within or without the seed is not necessary for the production of lactic acid, which is found in minute quantities inside all germinating seeds. Treatment with nutrients, stimulants or toxics does not generally evoke a similar response from seeds and associated bacteria; conditions favouring one form of life may be distinctly inimical to the other. Under natural conditions, seeds and soil micro-organisms are inevitable associates which are physiologically unrelated and live independently of each other.

405. A Powdery Mildew (*Erysiphe malachræ*) on Cotton from Peru. By E. V. Abbott. (*Mycologia*, Lancaster, Pa., xxiv., **1**, 1932. Noted in *Int. Rev. Agr.*, Rome, xxiii., **2**, 1932, p. M28.)

406. The Formation of "Diamond Spot" Stains by Mildew Fungi. By L. D. Galloway. (*J. of Text. Inst.*, xxii., **10**, p. T494.)

GENERAL BOTANY, BREEDING, ETC.

407. Development in Plant Genetics. By J. H. Neethling. (*Farming in S. Afr.*, vi., **71**, 1932, p. 485.) A clear and simple account of the development of the science of genetics, written for the farmer.

408. The Subsidiary Methods in the Breeding and Scientific Investigation of Cotton. By A. Pankina. (*Bull. Sci. Res. Cott. Inst.*, Tashkent, Nos. 7-8, 1931, p. 29. Abstr. from *Plant Breeding Abstracts*, ii., **2**, 1932, p. 78.) The success of any breeding work depends on the wealth of diversity of the original material. For this reason expeditions have been made and a collection built up which embraces all the diversity of all the cotton-growing countries of the world.

Among the material collected are varieties which, under the conditions of Central Asia, show no signs of boll-production until advanced autumn. Over 500 specimens of these are under investigation, and they possess a great number of very valuable characters. Some have large bolls weighing up to 8 g. Early ripening Egyptian types with bolls weighing 3-3·5 g. have appeared. Many of the late types have proved highly drought-resistant, suitable for poor soils, and resistant to a variety of diseases. The only difficulty is in inducing them to flower. For this purpose various methods have been tried: (1) Transplantation after indoor germination during the spring frosts. A lengthening of the period of vegetation of two to three months was thus obtained, and some of the late varieties were brought successfully to maturity. (2) Greenhouse cultivation of plants which in the field have failed to give seed. Various disadvantages of this method are enumerated, and it is only used to a limited extent. (3) Grafting. By grafting on to early varieties, late ripening plants can be greatly accelerated in their maturity. Late plants which have not matured in the field are also grafted on to plants growing in the greenhouse, and so brought to maturity. (4) Cuttings—with the object of enabling late ripening forms to complete their period of maturity in the greenhouse, and also as a means of multiplying rare plants or valuable heterozygous plants obtained by hybridization—*e.g.*, in the case of interspecific crossing—the hybrid *G. hirsutum* × *G. barbadense* being an example. The method of taking the cuttings is briefly described. Many groups of cotton—*e.g.*, *Gossypium punctatum*—are not capable of vegetative propagation in these ways, and suffer severely even from transplanting; in no case were the results fully satisfactory, and the search for better methods is being continued. (5) Length of day treatment. The cotton plant has been shown to be a short day plant, and by artificially reducing the period of insolation, flowering and ripening can be very much accelerated. In this way perennial cottons have been made to flower simultaneously with the local ones and valuable crosses effected—*e.g.*, Egyptian with large-bolled forms of *G. peruvianum*—resulting in a considerable rise in boll-weight of the early Egyptian types. The progeny are now in F_2 and are being further analyzed.

409. Effects of High Soil Moisture and Lack of Soil Aeration upon Fruiting Behaviour of Young Cotton Plants. By W. B. Albert and G. M. Armstrong. (*Plant Physiol.*, 6, **3**, 1931, p. 585. Abstr. from *Exp. Sta. Rec.*, 65, **9**, 1931, p. 825.) Cotton grown with high soil moisture conditions shed a larger percentage of fruit buds than plants under soil moisture conditions nearer optimum. Such increase in shedding was associated with the lower percentage of oxygen and higher percentage of carbon dioxide observed in flooded plats in contrast to unflooded plats.

410. Root Constriction of Cotton Plants in the San Joaquin Valley of California. By J. W. Hubbard. (*J. of Agr. Res.*, 44, **1**, 1932, p. 39.) Constriction was found to occur in a light sandy soil that had not been irrigated after planting, and if not too severe, was removed by subsequent irrigation.

411. Parthenogenesis in Cotton. By R. Balasubramaniam. (*Madras Agr. J.*, **19**, 1931, p. 509. Abstr. from *Plant Breeding Abstracts*, ii., **3**, 1932, p. 109.) The method used in making the crosses is described. A large number of crosses were made between *Gossypium indicum* and *G. hirsutum*. In the early stages the fruits developed well and only between the 20th and 30th days did pronounced shedding set in. An examination of the fruits showed that seeds of normal character and size had developed, although the interior was not completely filled up and the embryo was imperfectly developed. Growth curves were compared with those for normal fruits. These showed an abrupt cessation in growth at the end of three weeks. A very small number of good seeds was produced. To test the possibility of their having arisen by parthenogenesis, various plants of *G. indicum* were emasculated and the whole staminal column was removed. Out of 700 such flowers seven produced bolls, and of these four gave good seeds with lint. Flowers treated in such a way gave no more mature bolls and seed when dusted with pollen of the same variety or left uncovered, and the author is of the opinion that the seeds previously formed were the result of parthenogenesis. Cytological studies to test this are being undertaken.

412. FERTILITY IN HYBRIDS BETWEEN NEW AND OLD WORLD COTTONS. By S. C. Harland. (*Nature*, Vol. 129, No. 3254, 1932, p. 398.) The first hybrid between Asiatic and New World cottons ($n=13 \times n = 26$) was recorded and described by Zaitzev (*Agr. J. Ind.*, xx., p. 213; xxi., p. 460; xxii., p. 155). The parentage of this cross was *Gossypium herbaceum* (female) by *G. hirsutum* (male), and the resulting plants were, without exception, completely sterile on both female and male sides. Other workers have since confirmed Zaitzev's results. Since 1926, several thousand crosses between Asiatic and New World cottons have been made at this Station, using various races of each, both as female and male. Using Asiatics as female met with no success. Apparently sound seeds were often obtained, but these contained only minute, shrivelled embryos. Using New World as female, two hybrids were produced, and one of these, *G. barbadense*, L. × *G. arboreum*, var. *sanguinea*, although sterile on the female side, has proved to possess some functional pollen grains, since it will cross with *G. barbadense*. A detailed account of this interesting hybrid will be presented at a later date. The F_1 showed a flower " yellow, with a red flush at the petal edges, spot intermediate between the parents " and colour of leaves red but intensity reduced. In inter-Asiatic crosses, the complex red leaf, red flower, intense petal spot is inherited as a single unit character. Back-crosses were successfully made to various types of *G. barbadense*. Ultimately, eight healthy plants were raised to maturity. Of these eight plants, five showed the red-leaved character of *arboreum*, with a varying amount of red in the flower. This indicates that an Asiatic chromosome, or that part of it containing the red factor (R), was carried by some pollen grains. A considerable weakening of the effect of the R factor was found in some of the plants. Back-crossing with a New World type results in the Asiatic modifiers being eliminated or replaced by New World factors, since, if the Asiatic modifiers had been represented in *G. barbadense*, there would have been no reduction in flower colour or spot intensity. It is further evident that the R modifiers must be present in an almost homozygous condition throughout the Asiatic cottons, since they exhibit little or no segregation in inter-Asiatic crosses. The eight back-cross plants were again back-crossed with *G. barbadense* of various types in both directions. Three plants proved to be fertile on both female and male sides, and several seedlings from the second back-cross are now being studied. The great increase in fertility of the plants in the first back-cross suggests that one or more Asiatic chromosomes may be capable of functioning in a New World plant body. If this surmise is correct, the way is opened towards the synthesis of new types of cotton combining the desirable economic characters of the New and Old World groups of cottons. The cytology of these hybrids is being investigated by Dr. A. Skovsted at the Research Station, Trinidad.

413. Breeding of Disease-Resistant Crops. By T. R. Mehta. (*Agr. and Livestock in India*, i., **6**, 1931, p. 618.) A very readable discussion of the principles that underlie this subject, given under the following heads: Introduction; General considerations; Prevention of diseases; Plant disease a heavy tax; Mendelism and disease resistance; Breeding disease-resistant plants; Breeding of wheats resistant to rust; Some obstacles; Selection; Some achievements; Breeding with reference to different crops; Nature of disease resistance; Disease resistance against other agencies; A word of caution; Summary and conclusions.

414. Practical Plant Breeding on a Theoretical Basis. By W. Dix. (In German.) (J. Neumann. Neudamm, 1931. Abstr. from *Plant Breeding Abstracts*, ii., **2**, 1932, p. 98.) The book under review is a somewhat original contribution to the existing literature on plant breeding. It is written very much from the point of view of those who follow the German methods of plant breeding, where much of the breeding is in the hands of commercial organizations or private breeders. It takes the form of a series of discussions on different problems which concern the breeder, which incorporate a more or less popular explanation of the problem for those not versed in the science, and deliberations on various aspects of the problem, in which the practical side is emphasized and illustrated by examples frequently drawn from the author's personal experience. Many of the problems are regarded from an original point of view, and new explanations are offered for a number of phenomena.

415. Inheritance of Seed Weight and Lint Index Related to Hereditability of Lint Percentage in Cotton. By J. O. Ware. (*J. Amer. Soc. Agron.*, **23**, 1931, p. 677. Abstr. from *Plant Breeding Abstracts*, ii., **2**, 1932, p. 80.) Earlier work had shown that in crosses between (A) Pima × Winesap, (B) Pima × Upright, and (C) Winesap × Sea Island, low lint percentage was intensified in A and B, but that high lint percentage was incompletely dominant in C. These results are now further analyzed, and more data are provided on seed weight and lint index. Hybrid vigour, affecting seed weight, was found to account for the low lint percentage in the A and B crosses. The parents of the C cross were not genetically pure for this character. When the weight of lint from 100 seeds was taken as a standard, dominance was incomplete in the F_1 of A and B and complete in C. No (or hardly any) hybrid vigour in lint index was shown in A, B, or C. The investigations were continued in back-crosses and the F_2 generation.

416. Interspecific and Intergeneric Hybridization in Relation to Plant-Breeding. (Issued by the Imperial Bur. of Plant Genetics, Cambs., 1932. Price 2s.) A useful bibliography that " makes no claim to completeness, but only to be a very general survey of the literature on a vast and intricate subject, and an indication of its main features."

417. The Value of Hybridization in the Improvement of Crops. By M. Heynes-Wood. (*Calcutta Rev.*, March, 1932.) An essay dealing with the crops of India.

418. (i) Chromosomes of Cotton, Inheritance of Flower, Fruit, and Seed Characters. (*Der Züchter*, **4**, 1932, p. 9.)

(ii) Inheritance of Vegetative and Physiological Characters in Cotton and a Discussion of Further Questions relating to the Genetics of Cotton. By H. Emme. (*Der Züchter*, **4**, 1932, p. 39. Abstr. from *Plant Breeding Abstracts*, ii., **3**, 1932, p. 139.) A brief but comprehensive review (in German) of the published work on the classification, chromosome numbers and genetics of cotton.

419. INHERITANCE OF COROLLA COLOUR IN SOME INDIAN COTTONS. By G. L. Kottur *et al.* (*Ind. Jour. of Agr. Sci.*, i., **5**, 1931. p. 577.) *Summary.*—Crosses were made in 1925 and 1926 between white-flowered and red-flowered and yellow and red flowered cotton plants. In the F_1 generation, the colour of the corolla was red, though the intensity was not as much as that of parent, some dilution of colour being apparent. In the case of the yellow-flowered and red-flowered plants segregation in the F_2 was according to the simple Mendelian ratio, 3 : 1. In the case of the white-flowered and red-flowered plants segregation was on the basis of 9 : 3 : 3 : 1 ratio. F_3 segregation further proved the assumed hypothesis. Harland's explanation that yellow-flower colour is inherited on the basis of 39 : 9 : 16 ratio, involving 3-factor pairs, does not seem to be tenable from the data obtained in the crosses herein reported.

420. COTTON NOTES. By J. B. Hutchinson. (*Trop. Agriculture*, ix., **4**, 1932, p. 126.) *Inheritance of Corolla Colour in Some Indian Cottons.* Mr. Hutchinson discusses this paper by Kottur, Mundkur, and Maralihalli, on the inheritance of two genes R and Y, controlling the formation in the corolla of red (anthocyanin) and yellow (flavone) pigments respectively. The position is reviewed in some detail, especially with reference to the manner in which the yellow colours are produced, whether by Harland's basic gene or by Kottur's dilution hypothesis.

[*Cf* Abstr. No. **149**, Vol. I., 1924; No. **676**, Vol. VI., 1929; No. **696**, Vol. VIII., 1931, and **419** above.]

421. MAARAD COTTON. (*5th Congr. Internat. d'Agric. Trop.*, 1930. Abstr. from *Plant Breeding Abstracts*, ii., **3**, 1932, p. 139.) After a very brief indication of the origin of Maarad cotton by selection from Pima, itself a mutation from the Egyptian variety Mit Afifi, the qualities of the cotton are described and the views of the spinners quoted. It has given yields of 33 per cent. more than Sakel. (Giza 7 gives similarly high yields.) Its staple is longer than Sakel by 2-3 mm. and finer, its ginning outturn 2-3 per cent. more. It is more resistant to wilt than Sakel, is earlier and less attacked by pink bollworm. Its root system is shallower and it is somewhat less resistant to drought. In 1928 it was superior in strength to Domains Sakel, although in previous years it had been not so strong.

422. INHERITANCE IN GRAIN SORGHUMS, CORN, AND COTTON. By R. E. Karper *et al.* (*Texas Sta. Rpt.*, 1930. Abstr. from *Exp. Sta. Rec.*, 66, **1**, 1932, p. 22). In regard to cotton it is stated that when seeds of a virescent yellow strain were irradiated (X-ray) at different dosages, and then grown in the greenhouse, it was found that cotton seed could withstand a very heavy dosage of X-rays. While 100 kilovolts 5 milliamperes applied for 1 hour at a distance of 17 cm. did not decrease germination, the heavier treatment produced many dwarfed individuals. When transplanted to the field these plants developed as dwarfs, the extra dwarfs attaining a height of only 6 to 8 ins. The many chimeras produced in the leaves indicated somatic changes which were probably due in some cases to gene mutations and in others to chromosomal aberrations. Six plants from the okra leaf X-rayed line developed leaves intermediate in shape between okra leaf and normal leaf. This intermediate shape is typical for the heterozygous condition, and indicative that one of the genes for okra leaf was changed to the gene for normal leaf.

FIBRE, YARN, SPINNING, WEAVING, ETC.

423. BAUMWOLLE. By G. Kränzlin and A. Marcus. (Berlin: Deutscher Auslandverlag Walter Bangert, 1931. Price RM.6. Abstr. from *Bull. of Imp. Inst.*, xxx., **1**, 1932, p. 104.) This little work deals in a concise but practical manner with cotton and its production.

424. Cotton Research and Academic Physics. By F. T. Pierce. (*J. of Text. Inst.*, xxiii., **2**, 1932, p. 9.) Written to enable the academic mind to appreciate, understand, and re-interpret the problems of technology, and the industrialist to understand the view-point of the research worker.

425. The Molecular Structure of Textile Fibres. By W. T. Astbury and H. J. Woods. (*J. of Text. Inst.*, xxiii., **2**, 1932, T17.)

426. Staple Fibre-Cutting Apparatus. By Br. Celanese Ltd., London, F. C. Hale, and W. H. Kimpton. (E.P. 359,511 of 16/6/30. Abstr. from *J. of Text. Inst.*, xxiii., **2**, 1932, A69.) Describes cutting apparatus, in which filaments are fed laterally into the nip of a pair of overlapping circular knife-edged discs which co-operate to sever them.

427. The Stapling of Cottons. Laboratory Methods in Use at the Shirley Institute, 1931. By Gladys G. Clegg. (*J. of Text. Inst.*, xxiii., **2**, 1932, T35.) A valuable account, demonstrating the variability of cotton as a raw material, and describing a method of measuring some of the variables.

428. The Testing of Yarns and Fabrics. By H. P. Curtis. (Pubd. by Sir Isaac Pitman and Sons, Ltd., London. Price 5s. net. Abstr. from *J. of Text. Inst.*, xxiii., **1**, 1932, p. 8.) The tests mentioned are those which may be carried out by persons with little or no knowledge of scientific technique. The illustrations of various testing appliances are very good. The book contains a short glossary of textile terms used in the text.

429. " Simplex " Fibre Identification Device. By Etab. O. Jansoone. (*Rev. Fil. et Tiss.*, **17**, 1932, p. 32. Abstr. from *Summ. of Curr. Lit.*, xii., **6**, 1932, p.175.) The " Simplex " apparatus for the identification of textile fibres works on a physical principle (apparently electrostatic). It is claimed that cotton, wool, weighted and unweighted silk, and the different types of rayon can be identified and can be detected with certainty in mixtures by the use of this device, and that only a few seconds are required for each test.

430. The Cotton Paradox. What is the Immature Cotton Fibre, and the Possibility of its Use in the Textile Industry. By W. S. Federow. (In Russian.)

431. Maturity, Fineness and Strength of Cotton Fibre. By W. S. Federow. (Issued by All Union Res. Cotton Inst., Tashkent, U.S.S.R., 1931.) A detailed paper, in Russian with abstract in English, in which the methods of determining the chief properties of the cotton fibre—ripeness, fineness, and strength—are examined.

432. Immunized Cotton and its Uses. By C. E. Mullin and R. L. McGee. (*Text. Rec.*, xlix., **584**, 1931, p. 73.) A review of the patent literature covering the manufacture of immunized and passive cottons, dyes for, and dyeing and printing these materials.

433. The Determination of Sample Size for Diameter Measurements in Cotton Fibre Studies. By O. A. Pope. (*J. Agr. Res.*, **43**, **11**, 1931, p. 957.) The object of this paper, which is well furnished with graphs and tables of statistics, is to determine the smallest number of individual fibre diameter measurements that would constitute a statistically reliable sample. About 100 is the number regarded as giving a safe margin.

434. Single Process Opening of Cotton. By F. Coop. (*Text. Rec.*, xlix., **586**, 1932, p. 39.) Briefly, the system consists of a series of opening machines coupled together as a single unit, the cotton being delivered loose as distinct from a lap, and conveyed to either one or two hopper feeders, these being coupled to single beater scutchers forming a lap which passes direct to the card.

435. Cotton Opening Machines. By J. L. Rushton and C. Schofield (Bolton). (E.P. 365,752 of 29/12/30. Abstr. from *Summ. of Curr. Lit.*, xii., **6**, 1932, p. 162.) The effectiveness of machines for the preparatory treatment of fibrous textile materials, such as hopper bale breakers and hopper feeders, is increased by interposing between the inclined spiked lattice with its co-operating stripping roller and the endless spiked lattice conveying member, a feed mechanism to which the fibre is guided and through which it is passed in such a way that it is lightly held by the feed mechanism so as to delay it slightly whilst it is presented to the endless spiked lattice conveying member to undergo a supplementary opening and combing action by engagement with the spiked lattice member.

436. Cotton Opening Machine Grating Clearing Device. By J. Greenhalgh and Sons, Ltd., and R. and J. Greenhalgh (Oldham). (E.P. 366,200 of 5/12/30. Abstr. from *Summ. of Curr. Lit.*, xii., **6**, 1932, p. 162.) Describes improved means to prevent clogging of the air outlet gratings of cotton opening and cleaning machines.

437. Cotton Opening and Cleaning Machinery: Lay-out. By B. Kirschner. (*Textilber.* **12**, 1931, and **13**, 1932. Abstr. from *J. of Text. Inst.*, xxiii., **4**, 1932, A169.) The improvement of cotton cleaning equipment is discussed, and schemes of machinery combination for fibre of different type and quality are shown diagrammatically.

438. Automatic Weft-replenishing Looms. By K. Sakamoto (Hamamatsu, Japan). (E.P. 359,488 of 18/7/30. Abstr. in *J. of Text. Inst.*, xxiii., **2**, 1932, A81.)

439. In Favour of Automatic Weaving. By M. Procter-Gregg. (*Text. Rec.*, xlix., **586**, 1932, p. 37.) Discusses the question of hours and of wages.

40. Automatic Weft-replenishing Mechanism. By J. Whittaker (the late) and Whittaker Automatic Looms Ltd., Blackburn. (E.P. 359, 166 of 30/9/30. Abstr. in *J. of Text Inst.*, xxiii. **2**, 1932, A80.)

441. Automatic Looms: Effect on Indian Cotton Mills. By B. B. Joshi. (*Indian Text. J.*, **42**, No. 493, 1931. Abstr. from *Summ. of Curr. Lit.*, xii., **3**, 1932, p. 88.) The advantages of automatic looms are outlined and figures showing estimated savings in costs of production are reproduced. One estimate is supplied by the British Northrop Loom Co., who calculate a return of 27 per cent. on the extra capital outlay under Indian conditions. The author does not accept a figure of more than 6 per cent., whilst the Cotton Textile Industry Inquiry Committee in 1927 claimed that automatic looms would not pay in India. The necessity for technical ability is pointed out and the reorganization of labour involved in the introduction of automatic looms is discussed.

442. Shuttleless Loom. By C. H. Baddeley (Bradford). (E.P. 363,219 of 14/2/31. Abstr. in *Summ. of Curr. Lit.*, xii., **3**, 1932, p. 64.)

443. Automatic Looms: Tests. M. Procter-Gregg. (*Text. Weekly*, **8**, 1932, p. 652. Abstr. from *Summ. of Curr. Lit.*, xii., **6**, 1932, p. 164.) Tests were carried out with Northrop looms, Toyoda looms, Stafford looms, Whittaker weft replenishing attachments, Terry weft replenishing attachments, Gawsworth looms with continuous weft supply, and ordinary Lancashire looms, using forty looms in each case. The cloth was the same on all looms, and was made from 24's yarn with 66 picks and 59 ends per inch, 34½ inches wide, 117 yards to the piece. Difficulties were experienced with the Gawsworth and Terry looms, and after weaving off a few beams both types were omitted from the test. Figures showing the lengths, widths, and weights of the cloth, and speeds, efficiencies and productions are given for the other looms. The Northrop looms showed the highest efficiency and the least variation in the cloth produced. From the records of the test and basing automatic loom organization on the tackler's set, it is shown that the number of looms per operative is 10 Northrop, 6½ Toyoda, 7 Stafford, 6 Whittaker, and 3½ ordinary. The production per weaver per week, in pieces of cloth of 117 yards, works out to 82, 41, 61, 29, and 7½.

444. UTILIZING WASTE MATERIALS. (*Text. Rec.*, xlix., **587**, 1932, p. 85.) Speaking with reference to the new process for utilizing waste materials for making yarns of the worsted type, which has been evolved at the Bradford Technical College, Professor Midgley states that there are six instances in Lancashire where the process is receiving attention. One firm is putting down £10,000 worth of new machinery for the process, using it in conjunction with cotton spinning.

445. COTTON VENEER WALL COVERINGS. (*Int. Cott. Bull.*, x., **37**, 1931, p. 141.) A new use for cotton cloth has been developed recently in the United States in the shape of a combination of rare and costly wood veneers backed by cotton material. This is increasing in favour with architects and decorators to replace solid wood panelling in offices, private homes, hotels, restaurants, yachts, showrooms, as well as passenger lifts, etc.

446. TEXTILE FIBRES AND THEIR USE. By K. P. Hess. (J. P. Lippincott Co., Chicago, Philadelphia, and London, 1931. Price 10s. 6d. Abstr from *Bull. of Imp. Inst.*, xxix., **4**, 1931, p. 496.) Consideration of the textile fibres is restricted to the five fibres of which most clothing and household fabrics are composed —viz., wool, silk, cotton, linen, and rayon.

447. COTTON: NEW AND EXTENDED USES. By G. A. Sloan. (*Text. World*, **80**, 1931, p. 1597. Abstr. from *J. of Text. Inst.*, xxiii., **1**, 1932, A55.) A review of the uses of cotton and the directions in which its use may be extended. Some indications are given of the consumption of cotton by various industries in the U.S.A.

448. LOOSE COTTON COLORIMETER. By D. Nickerson. (*J. Opt. Soc. Amer.*, **21**, 1931, pp. 640 and 643. Abstr. from *J. of Text. Inst.*, xxiii., **1**, 1932, A42.) Diagrams of the instrument and the optical system are given. The measurement of colour in terms of hue, brilliance and saturation is discussed.

449. RAW COTTON: COLOUR. By D. Nickerson. (*Amer Dyes. Rep.*, **21**, 1932, p. 4. Abstr. from *Summ. of Curr. Lit.*, xii., **5**, 1932, p. 139.) The variations in the colour of raw cotton and their importance in grading and in bleaching and dyeing are discussed, and an indication is given of the research on colour measurement and standardization, for which the author's colorimeter was designed.

[*Cf.* Abstr. 448, above.]

450. COTTON, ADSORPTION OF NEUTRAL SALTS BY. By A. Lottermoser and W. Hönsch. (*Kolloid Z.*, **57**, 1931, p. 206. Abstr. from *Summ. of Curr. Lit.*, xii., **1**, 1932, p. 19.) The amounts of lithium chloride, sodium chloride, potassium chloride, calcium chloride and potassium thiocyanate taken up by cotton have been measured, and curves constructed showing the variation in the amount with time. In the case of lithium chloride the curve shows a minimum after a period of 30 hours. For the other salts the curve shows a maximum after 30-48 hours. The relation between the amount of salts taken up and the concentration of the solution is also shown graphically.

451. COTTON SPINNING MILL TESTING. By "Essbee." (*Text. Rec.*, xlix., **587**, 1932, p. 31; **588**, p. 34.) Describes blowing room, comber, drawing sliver, speed frame and yarn tests, and testing for moisture.

452. Operatives: Industrial Efficiency. By S. Wyatt. (*J. Nat. Inst. Ind. Psychol.*, **6**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii, **4**, 1932, p. 118.) Deals with the desirable and undesirable factors associated with conditions of work.

453. Determining Forms of Tendering in Cotton Yarns. By N. Ellis. (*Text. Rec.*, xlix., **586**, 1932, p. 29.)

TRADE, CO-OPERATION, ETC.

454. Cotton Year Book, 1932. (Published by *Text. Mercury*, Manchester, Price 7s. 6d. net. Abstr. from *J. of Text. Inst.*, xxiii., **3**, 1932, p. 48). This is the twenty-seventh issue of an annual now well known and appreciated. Surveys of development have been included, and will be welcome additions to this reference book.

455. Lancashire Cotton Pageant. We have received the prospectus of the Lancashire Cotton Pageant which is to be held at the Belle Vue Gardens, Manchester, from June 25 to July 9. It is being elaborately staged on a scale never before attempted, and will depict the story of cotton through the ages. There will be 12,000 performers, and the pageants will represent the following among other subjects: A Persian Market Scene; The Court of William the Conqueror; A Cotton Plantation; The Age of Inventions; The Progress of Transport; Lancashire Market Day; Lancashire at Work; Lancashire at Play. The Pageant Book may be obtained (price 1s. 4d. post free) from the Pageant Book Office, Belle Vue, Manchester.

456. The Cotton Trade and Industrial Lancashire, 1600-1780. By A. P. Wadsworth and Julia de L. Mann. (Published by Man. Univ. Press. Price 25s. net. Reviewed in *J. of Text. Inst.*, xxii., **12**, 1931, p. 197.) This very appreciative review ends as follows: " Such an admirable piece of historical research is bound to inspire others to take a hand in unfolding the whole story of textile developments. For the technician it is also sure to yield a new pride in his craft."

457. The Cotton Industry in 1931. By W. H. Slater. (*Text. Rec.*, xlix.. **586**, 1932, p. 25.) Discusses among other matters the question of more looms, wages and hours, the state of trade, and the general outlook for the industry.

458. Some Suggestions for the Cotton Trade. (*Text. Rec.*, xlix., **586**, 1932, p. 23.) Points out the need for revision of the whole question of prices, with the other changes which this will involve.

459. World's Cotton Consumption and Stocks. A Half-Yearly Stock-taking. By J. A. Todd. (*Man. Guar. Coml.*, 19/3/31, p. 205.) A good general account with graphs and tables of figures.

460. Cotton Trade Prices: Effects of Sterling Depreciation. By W. H. Slater (*Text. Weekly*, **8**, 1931, p. 370. Abstr. from *Summ. of Curr. Lit.*, xii., **1**, 1932, p. 24.) Index numbers of cotton trade prices and price comparisons of silver in terms of gold and cotton piece-goods are given, together with a graphical analysis of the more important price indices.

461. " Outside Growths " Cotton: Consumption. By J. A. Todd. (*Man. Guar. Coml.*, **23**, 1931, p. 505. Abstr. from *Summ. of Curr. Lit.*, xii., **1**, 1932, p. 2.) An attempt has been made to analyze the world's consumption of outside growths of cotton, distinguishing between foreign and Empire cottons. A second table gives details of the world's consumption of American, Indian, and Egyptian cotton, and sundries split up into Empire and "others," for the seasons 1925-26 onwards.

462. COTTON PRICES AND PARITIES, RECENT MOVEMENTS IN. By J. A. Todd. *Text. Weekly*, **8**, 1932, p. 536. Abstr. from *Summ. of Curr. Lit.*, xii., **5**, 1932, p. 154.) The Liverpool-New York discounted prices and parities for American cotton and the Alexandria-New York parities for Egyptian cotton are given for each Tuesday and Friday since September, 1931. The fluctuations are shown by curves, and their causes are discussed. It is pointed out that Indian cotton is at present apparently much too high-priced in relation to American, whilst Egyptian cotton, especially Uppers, is relatively very cheap.

463. ÉTUDES ÉCONOMIQUES; PRODUCTION DU COTON ET SA CONSOMMATION DANS LE MONDE. By J. Ausset. (*Coton et Cult. Coton.*, vi., **2**, 1931, p. 149.) A simple statistical account of the position up to 1930-31.

464. THE CRISIS IN THE COTTON INDUSTRY AND THE WORLD CRISIS. By A. Siegfried. (*Int. Cot. Bull.*, x., **37**, 1931, p. 16.) A thoughtful discussion of the subject under the following heads: (1) The world-wide economic crisis; (2) the crisis in the cotton industry in relation to the general world crisis; (3) the evolution of the crisis.

465. THE WORLD'S COTTON POSITION. By J. A. Todd. (*Int. Cott. Bull.*, x., **37**, 1931, p. 135.) The fall in prices is attributed to the restriction of consumption, and the relative consumption of American and outside growths is discussed.

466. COTTON PROPAGANDA. By P. Schleich. (*Int. Cott. Bull.*, x., **37**, 1931, p. 8.) The general outline of the contents of this paper is indicated by the first paragraph: "Cotton propaganda means more than a mere advertising stunt: it is rather a combination of actions to be commenced in the various processes of manufacture, with the aim of a permanent 'renaissance' of the cotton industry, which may be classified under three headings: (1) Increased improvement in output and quality on the part of the industry in order to make cotton goods a more suitable subject for propaganda and more interesting and attractive to the consumer. (2) The finding of new uses for cotton or cotton goods. (3) Execution of a predetermined 'propaganda campaign' on the basis of headings 1 and 2."

467. THE RETAILER'S VIEW OF TEXTILES. By J. G. Williams. (*Text. Rec.*, xlix., **588**, 1932, p. 39, and subsequent issues.) Discusses the subject under three heads: Why and how do the general public buy the goods in the shop? What comments have the buyers for the retail trade to make on the goods offered? What are the common grounds for dissatisfaction against textiles on the part of members of the public?

468. WORLD ALTERATIONS IN TEXTILE RAW MATERIAL SUPPLIES. By Dr. A. Niemeyer. (*Text. Rec.*, xlix., **588**, 1932, p. 32.)

469. COTTON PIECE GOODS: EXPORTS TO SOUTH AMERICAN MARKETS. By W. H. Slater. (*Text. Weekly*, **8**, 1931, p. 222. Abstr. in *J. of Text. Inst.*, xxiii., **1**, 1932, A55.)

470. TECHNICAL TERMS IN THE TEXTILE TRADE. By E. Midgley. (Pubd. by Emmott and Co., Ltd., Manchester. Price 12s. 6d. net. Abstr. in *J. of Text. Inst.*, xxiii., **3**, 1932, p. 47.)

MISCELLANEOUS.

471. The Imperial College of Science and Technology. We have received a copy of the 24th Ann. Rpt. of the Governing Body for the year 1931. The past year has seen some reorganization and some extension of the educational work of the College, which otherwise has been marked by steady development on established lines. The completion of the new wing, which was taken into use in January, 1931, increased the total possible number of residents to 101. Although the new wing was opened in the middle of the College session, 80 per cent. of the new accommodation was taken up immediately, and more than sufficient applications were received to ensure that from October, 1931, all the rooms would be in use.

472. Imperial College of Tropical Agriculture, Trinidad. The Principal's Report, 1930-31, describes briefly the research work that is being carried out, and states that steady progress has been made. The new Cacao Research Scheme has been launched. Additional improvements have been made to the library which should result in ample accommodation being available for the next few years. The total number of publications now in the library is 26,167. A list is given of some thirty-two papers published during the year, and the journals in which they appeared.

In the report of the Advisory Dept. of Agriculture, it is stated that "the Cotton Research Officer at St. Vincent, Mr. S. H. Evelyn, has made satisfactory progress in his work of developing good strains of Sea Island cotton in that colony, and has also visited St. Kitts and Montserrat in connection with the cotton crop and seed supply. Dr. Harland also visited Montserrat and submitted a report on seed selection work. The Department is greatly indebted to the Empire Cotton Growing Corporation for their valuable assistance in this respect."

473. The Methods of Statistics. By L. H. C. Tippett. (Williams and Norgate, Ltd., London, 1931. Price 15s. net.) Modern statistical methods are developed from first principles, and their use is illustrated, so that students with little previous acquaintance with the subject may obtain a good working knowledge and understanding of the methods available. Although the examples are biological, the treatment is general, and should be useful to all who work with variable materials. The first chapters deal with frequency distributions and constants, and with the theory of errors, in orthodox manner, but in the later chapters the underlying theme is Fisher's idea of the Analysis of Variance; correlation is introduced as a special case of this. The author states that there are, of course, other ways of regarding the subject, but in his view its unity is brought out more by this than by any other method of presentation. The book is furnished with a good index and a list of references.

474. "Commercial Oldham." The Textile Exhibition number of this journal contains some interesting short articles, among which may be mentioned: "The Future of the Cotton Spinning Industry," by H. Boothman; "Oldham: Advantages for New Industries," by Dr. J. J. Williams; "Salesmanship," by Sir Francis Goodenough, C.B.E.; "India," by Hamilton W. Kerr, M.P.; "The Fetish of Rationalization," by A. Watson.

475. The Manufacturing Industries of the British Empire Overseas, Pt. VI.: Africa—West, East, and Central. (Pubd. by Erlangers Ltd., 4, Moorgate, London, 1932. Price 7s. 6d.) We have received a copy of this volume, which concludes the series of six monographs embracing the whole field of the British Empire Overseas, with the exception of the Irish Free State, India, and a few outlying countries in the Pacific. In the preface the causes of the world crisis are reviewed, and the importance of the forthcoming Imperial Conference at Ottawa is stressed. The difficulties facing the Conference are discussed, and it is considered that if viewed imperially they will be overcome.

Diagrams are included in the volume showing in a condensed form the present tariffs of all the British countries in Africa; comparative statistics of all countries in Africa, both British and foreign; a synopsis of the history and economic position of each British country in Africa, together with the imports and exports for the years 1926-30 of the principal goods. Statistics are also included, for the year 1930, of the imports of cotton manufactures into the British colonies in Africa, with the principal countries of origin.

ADDENDUM.

476. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d., post free.) The third number of Series A, Genetics, has recently been issued, and contains the following papers, reprinted from the *Journal of Genetics*:

THE GENETICS OF COTTON. Pt. V. "Reversal of Dominance in the Interspecific Cross *G. barbadense*, Linn. × *G. hirsutum*, Linn., and its Bearing on Fisher's Theory of Dominance." By S. C. Harland. Crosses of Crinkled Dwarf × Sea Island exhibit complete dominance of Sea Island, but in crosses with other Peruvian types, dominance is slightly disturbed, producing in F_1 normals with a slight trace of crinkling and some variation of the Crinkled class in F_2. A cross of Crinkled Dwarf × Upland gave an intermediate F_1 with dominance becoming increasingly manifest in back-crosses of heterozygote to Upland. Selfed heterozygotes from the first back-cross produced in one case a family indicating true reversal of dominance, the ratio 3 Crinkled : 1 normal being obtained. Reversal of dominance persisted in the next generation from this family. Crosses involving Crinkled and *G. sturtii* gave F_1 strongly crinkled, but a heterozygous Crinkled × *G. sanguineum* gave F_1 only slightly crinkled. The bearing of the experiments on Fisher's theory of dominance is discussed, and it is concluded that while the behaviour of Crinkled in Upland crosses is in accordance with the Fisher theory, the process by which genes modifying dominance are thought to have become homozygous in Peruvian involves the assumption that normals descended from heterozygotes have replaced the original normal population. This assumption is thought to be improbable.

Pt. VI. "The Inheritance of Chlorophyll Deficiency in New World Cottons." By S. C. Harland. The occurrence of relative chlorophyll deficiency in crosses between *G. barbadense* and *G. hirsutum* is shown to be dependent upon three pairs of factors, probably independently inherited, which are designated as follows:

$C^{ha}\text{-}c^{ha}$ — Green deficient.
$C^{hb}\text{-}c^{hb}$ — ,,
$C^{hc}\text{-}c^{hc}$ — ,,

Modifying factors considerably affect the distribution of chlorophyll deficiency in the chlorophyll-deficient class, and within it was found a range from completely lethal to fully viable. The distribution of the chlorophyll-deficient factors was investigated in *G. barbadense*, *G. hirsutum*, and *G. tomentosum*. *G. barbadense* carried only C^{ha}, *G. hirsutum* always carried C^{hb}, but C^{hc} was found in all three phases of the gene—$C^{hc}C^{hc}$, $C^{hc}c^{hc}$, and $c^{hc}c^{hc}$. *G. tomentosum* carried the combination C^{ha} with C^{hb}.

Pt. VII. "Crumpled: A New Dominant in Asiatic Cottons Produced by Complementary Factors." By J. B. Hutchinson. Two complementary factors, A and B, causing abnormal development, have been demonstrated in Asiatic cottons. A has been found in two strains of *G. Nanking* var. *soudanensis* obtained from the Sudan. B has been found in seventeen varieties of *G. arboreum*, *G. Nanking*, *G. herbaceum*, and *G. obtusifolium*, and in a strain of *G. Stocksii* from Sind. The existence of a number of modifying factors affecting the degree of expression of the " crumpled " character has been demonstrated. It was not possible to correlate either A or B with any character in normal plants. Examination of sections from near the growing point of a " crumpled " seedling revealed no marked abnormalities.

PUBLICATIONS RECEIVED

We have to acknowledge the receipt of the following publications for the Library.

From Edinburgh and East of Scotland College of Agriculture.

CADMAN, E. J.: *The Life-History and Cytology of " Didymium nigripes, Fr."*
FENTON, E. WYLLIE: *Poisonous and Milk-Tainting Plants.*
ROBERTSON, MAJOR E. D. S.: *Symptoms and First Aid to Stock.*

From the Imperial Bureau of Soil Science, Rothamsted, Herts.

KEEN, B. A., AND CASHEN, G. H.: *Studies in Soil Cultivation. VI. The Physical Effect of Sheep Folding on the Soil.*

SCHOFIELD, R. K., AND SCOTT BLAIR, G. W.: *Rapid Methods of Examining Soils. I. Measurements of Rolling Weights.*

SEN, A.: *The Electrical Conductivity of Aqueous Soil Suspensions as a Measure of Soil Fertility.*

The Measurement of Electrical Conductivity of Aqueous Soil Suspension and its Use in Soil Fertility Studies.

DE SIGMOND, A. A. J.: *The Reclamation of Alkali Soils in Hungary.*

Summaries of Papers Read at the Sixth International Congress of Tropical and Sub-Tropical Agriculture, Paris, 1931.

Publications on Soil Science issued from the Empire Overseas during 1931.

PERSONAL NOTES

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes " home " on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

Gold Coast	Mr. J. D. Broutch.
,,	Mr. N. P. Chambey.
,,	Mr. G. S. Cotterell.
,,	Mr. G. Cowan.
,,	Mr. G. H. Eady.
,,	Mr. C. L. Skidmore.
,,	Mr. J. T. H. Steele.
India	Dr. W. Burns.
,,	Mr. W. J. Jenkins.
Kenya Colony	Mr. W. D. D. Jardine.
,,	Mr. R. J. Lathbury.
,,	Mr. W. G. Leckie.
,,	Mr. W. L. Watt.
,,	Mr. H. Wilkinson.
Nigeria	Mr. E. W. Leach.
,,	Mr. J. P. Maule.
,,	Mr. J. H. Palmer.
,,	Mr. J. B. G. Savory.
,,	Mr. C. B. Taylor.
Nyasaland	Mr. A. J. W. Hornby.
Northern Rhodesia	Mr. R. H. Fraser.
,, ,,	Mr. T. McEwen.
Southern Rhodesia	Mr. J. C. F. Hopkins.
Sierra Leone	Mr. F. C. Deighton.
,,	Mr. G. M. Roddan.
Tanganyika	Mr. L. C. Edwards.
,,	Mr. B. J. Hartley.
,,	Mr. R. D. Linton.
,,	Mr. G. H. Pattinson.
Uganda	Mr. C. G. Hansford.
,,	Mr. G. W. Nye.
,,	Mr. N. G. Wright.
West Indies (St. Lucia)	Mr. E. A. Walters.

The following officers of the Corporation's staff abroad are on leave in this country:

South Africa	Mr. S. Milligan.
,,	Mr. O. V. S. Heath.
,,	Mr. D. Macdonald.
Southern Rhodesia	Mr. J. E. Peat.
Sudan	Mr. T. Trought.
Swaziland	Mr. J. V. Lochrie.
Trinidad	Mr. J. B. Hutchinson.
,,	Dr. E. Phillis.
,,	Dr. A. Skovsted.

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SPINNING TESTS

WHILE it is hoped that, as an outcome of the work of the British Cotton Industry Research Association and other bodies, it may ultimately be possible for the user of raw cottons to be able to judge the spinning properties of a sample from a knowledge of its hair characters, it remains true that the actual Spinning Test is the only one available for this purpose at the present time. This being so, it is of importance that all possible steps should be taken to make this test give as full and accurate information as possible, and thus advantage both the user and the grower of cotton. A first step towards this end is to endeavour to bring into closer touch with each other those who grow the samples and those who test them. According to Dr. Balls, writing in his book on "Quality in Cotton": "A mere numbered sample of cotton which comes home for testing can but rarely be regarded with the same interest, even affection, as is given to that same sample by those who consigned it after sowing, cultivating, and even breeding it. Such a sample has its own individuality; it is merely one of a series of victims when it reaches the spinning laboratory or mill." This obstacle is most likely to be overcome if the fullest exchange of information can be secured. On the one hand it is desirable that those in the spinning laboratory should be able to realize more clearly than is sometimes possible at present the objects of the experiments of which the samples sent for test are the outcome, and to gain some insight into the kind of difficulties that have to be encountered in field experimentation. Moreover, details of the agricultural characters of a sample and the conditions under which it was produced may throw light on the reasons for some of the results obtained in the spinning tests and in the determinations of the hair characters. On the other hand those who receive the results of such tests frequently feel the need for an indication of the degree of accuracy that should be attached to the several measurements and determinations, and for some guidance as to the general interpretation of the results.

The principal object of this note is to describe the steps that the Corporation are taking to effect this exchange of information, which will undoubtedly add to the usefulness of the spinning tests, and may perhaps bring nearer the time when such tests may give way to hair measurements which will give the necessary information as to a sample's spinning properties.

In the Corporation's last Annual Report attention was drawn to the desirability of supplying as full information as possible as to the past history of a sample to be tested, in a paragraph reading as follows:

> " While every possible care is taken to render the tests as accurate and informative as possible, those in charge of the testing are handicapped if they are not fully informed of the *object* of the tests, and of the relative agricultural merits of the samples submitted. In such circumstances, they may unwittingly fail to give all the assistance possible to the cotton breeder. Not only would the general remarks be more valuable when written with a complete understanding of the problem of the breeder, but even the individual treatment in the spinning tests might sometimes be modified with advantage in the light of the information received, with a view to obtaining additional knowledge of the spinning capacities in exceptional cases, without in any way affecting the comparative basis of the tests. In a revised form for recording the spinning test results, columns have accordingly been allotted for specific agricultural details—' yield per acre,' ' ginning outturn,' ' type of gin,' etc., when these are supplied by the sender of the samples. It would also add to the usefulness of the tests if the cotton breeder could state the latest date by which the reports should be received by him to be of use in determining the sowing policy for the following season; while it might not always be possible to issue the complete report in the time available, an effort would be made to supply at least a useful preliminary report if such were desired."

With a view to ensuring that full agricultural particulars are forwarded with each sample, a supply of forms is being issued to the Departments of Agriculture and to the Corporation's Experiment Stations from which samples are normally received, on which the sender will be asked to supply full information in respect of each sample forwarded, including such details as—the object of the experiments in connection with which spinning tests are required, the meteorological conditions during the growing season, the dates of sowing and picking, and the incidence of pests and diseases, as well as particulars of agricultural characters of the samples themselves, such as yield per acre and ginning outturn.

With the view of providing senders of samples with some help in interpreting the results of spinning tests a note intended to fulfil this object is appended on p. 265.

In view of the fact that the procedure followed at the Shirley Institute in the examination of samples and their testing has been somewhat modified since a description was given in the Corporation's Annual Report issued in 1931, an account of the present practice may usefully be given at this point:

A Joint Spinning Tests Sub-Committee, consisting of representatives of both the Corporation and the British Cotton Industry Research Association, examines all samples sent by the Corporation, after they have been submitted to the Liverpool Cotton Association for broker's reports. Opinions are expressed on each cotton as to its marketable value and general characteristics, and especially as to suitable counts for spinning tests. The advisability of spinning to more than one count has often been emphasized, and it is the general practice now to spin every sample to at least two counts, one being that advised by the Sub-Committee and the other being decided by the hair characters of the cotton and its behaviour in spinning to the first count. The processing has now been completely standardized; a standard range of counts has been adopted, and all samples are prepared and spun with standard twists to two or more of the standard counts, so that a proper basis is now provided for comparing the results of the spinning test for any cotton with those for other cottons, other conditions of growth, or other seasons.

Controls are supplied by similar standard spinnings from standard types of commercial cottons—Sakel, Uppers, American, etc.—which are repeated at intervals.

The processing is begun as soon as the hair-test results for length and hairweight are available, as these enable the roller settings, twist factors, etc., to be decided.

The complete hair test, styled the "Combined Stapling Test," comprises measurements of length, hairweight per centimetre, and immaturity, and gives the essential information in as concise a form as it has been found possible to devise. Details of these measurements and their interpretation are given in section (*a*) of the note below on the Interpretation of Cotton Spinning Test Reports. The variability of the raw material has made it essential to follow a special and rather lengthy sampling technique for these hair tests, as described in the Corporation's last Annual Report; and, as a further safeguard, all the hair tests are now done in duplicate by two independent observers.

In the actual processing, each sample is passed twice through the scutcher, and is then carded; it is weighed before and after scutching, and before and after carding, so that the gross percentage losses can be calculated. Notice is taken of any abnormality in the various types of waste produced.

If the sample is to be combed, it is next prepared for this process by being passed through a sliver lap machine and ribbon lap machine. The comber is first set to remove a standard percentage from the control; the sample is fed and a waste test taken. This gives a figure for the percentage loss at standard setting. The machine is now readjusted so that the percentage lost by the sample is equal to the standard percentage, and the cotton is run through at this readjusted setting. This method gives figures for the relative wastiness of the various samples, but ensures at the same time that comparison of the yarns spun is not affected by differences in comber losses.

The succeeding processes in the card room call for no comment, beyond the note that maximum elasticity has been achieved by the division of every frame into three sections, for long, medium, and short-stapled cottons respectively. The atmosphere of the card-room is conditioned at a standard humidity and temperature of 55 per cent. R.H. and 70-75° F. respectively.

The spinning room is similarly controlled at 65 per cent. R.H. and 70-75° F. The ring frames are in four sections—viz., long staple, medium staple, short staple, and high draft—with 16 spindles to each section. The spinning room is also equipped with one mule capable of spinning a wide range of counts; it has 200 spindles, and standard rovings are prepared to supply the vacant spindles whenever mule yarn is required from the samples. A record is taken of the number of breakages occurring during spinning (see section (*b*) (7) of the appended note).

The yarn is allowed to stand a few days immediately after spinning, and is then tested for lea strength, work of rupture, actual count, and winding breaks, in an atmosphere controlled at 65 per cent. R.H. and 65-70° F. The significance of these tests is discussed in section (*b*) of the appended note.

There is no satisfactory impersonal test for yarn appearance, and the yarns resulting from the spinning test are wound on black cards and submitted to the Joint Spinning Tests Sub-Committee for their personal judgment. The importance of yarn appearance is discussed in section (*b*) (6) of the appended note.

NOTE ON THE INTERPRETATION OF COTTON SPINNING TEST REPORTS AND AN EXPLANATION OF SOME TECHNICAL TERMS USED THEREIN.

(*a*) *Terms used in Hair Tests.*

(1) *Effective Length* is obtained by a simple geometrical construction from the Baer Sorter diagram. Its value is approximately the same as the grader's "staple," and appears to be a guide to the best roller settings in spinning. The figures given are accurate to about 3 per cent.—*i.e.*, in cottons of about 1-inch staple, differences of more than $\frac{1}{32}$ inch can be considered real.

Percentage Dispersion is intended to convey some idea of the variation of staple length in a sample by indicating the steepness of the slope of the middle part of the Baer Sorter diagram. This figure is not capable of very accurate determination and no significance should be attached to any difference less than 20 per cent. of the Percentage Dispersion itself.

Percentage Short Fibre is the percentage number of hairs shorter than half the effective length; such short fibres contribute to "wastiness," and are probably disadvantageous in spinning. The accuracy of this quantity is of the same order as that of Percentage Dispersion.

(2) *Hairweight per centimetre* is expressed by the mean of five determinations on groups of hairs of different lengths taken from the Baer diagram. A low hairweight per centimetre may be due to either (i.) an inherently fine hair, normally thickened; or (ii.) a thin-walled hair of large original cell-diameter. The distinction between these is made by the "immaturity test" (3). The accuracy of the hairweight measurement is rather less than that of the effective length, and differences of less than 7 per cent. should not be considered real.

(3) *Immaturity* is expressed by two figures—the *percentage number of normal hairs*—*i.e.*, normally thickened hairs, and the *percentage number of dead hairs*—*i.e.*, hairs with very little or no secondary thickening. Each figure is the mean of five determinations on groups of hairs of different lengths, classified according to their behaviour when subjected to the swelling effect of caustic soda

solution. Besides the "normal" and "dead" classes of hairs, a third class is distinguished, consisting of "thin-walled" hairs, the percentage of which can be obtained from the reports by subtracting from 100 the sum of the percentages of "normal" and "dead" hairs. For a well-matured cotton over 65 per cent. normal hairs, and not more than 10 per cent. dead hairs, may be expected. The standard error for the percentage number (n) of hairs in any one class is—

$$\sqrt{\frac{n}{10}\,\frac{(100-n)}{10}}$$

In general, the desirable features in a cotton are: (1) a high value of "effective length" combined with low values of "percentage dispersion" and "percentage short fibre"; (2) low hairweight per centimetre, and high uniformity of hairweight per centimetre for hairs of various lengths; (3) a low percentage of dead hairs.

At present it is impossible to say what is the precise significance to be attached to the value of any single property; when this problem has been solved it should be possible to predict the spinning value of a cotton from a knowledge of its hair-characters.

(b) *Terms used in Spinning and Yarn Tests.*

(1) *Actual Count* is the measured count, which may differ slightly from the nominal count (indicated by the yarn reference number) owing to unavoidable inaccuracies of draft.

(2) *Twist Factor* is a measure of the angle which the surface hairs make with the axis of the yarn. To make this angle the same for yarns of different count, and their twists therefore "equivalent," the twist inserted must be such that

$$\frac{\text{Turns per inch}}{\sqrt{\text{count}}} = \text{Constant (K)}$$

where the constant (K) is the *twist factor*, sometimes called the "twist constant" or "twist multiplier."

(3) *Lea Strength* is still regarded as the primary test of yarn quality, as yarn is often bought and sold on the basis of this test. The accuracy of the figure given for lea strength can be determined from the values of "Standard Deviation (per cent.)" or "Coefficient of Variation" given in the test. As a general rule it is safe to consider no differences significant if they are less than 5 per cent.

(4) *Work of Rupture* of a lea of yarn is measured on the Ballistic Tester; it measures tensile strength and extension jointly, and is therefore another useful criterion of yarn quality and of the performance

of the yarn in processes subsequent to spinning. The test must be regarded as a supplementary one, and not as a substitute for the lea test. If two yarns give identical lea tests, that with the higher ballistic test is to be preferred; but it is difficult to advise a preference in the case of two yarns which are placed in the reverse order by the two tests. At the moment it is safest to accept the lea test as the measure of yarn strength and to refer to the ballistic test in doubtful cases. The accuracy of the ballistic test is of about the same order as that of the lea test.

(5) *Count-Strength Product and Count-Work Product.* In comparing yarns for lea strength and work of rupture it is necessary to take into account the small differences in the actual count which, as noted above, are unavoidable. This is done by means of the products, lea strength × actual count, and work of rupture × actual count; these products can only be used in comparing yarns whose actual counts do not differ by more than about 5 per cent.

(6) *Appearance.* Yarn appearance is a complex thing involving regularity of diameter, hairiness, cleanliness, neppiness, etc. Neppiness is generally referred to separately in the reports, and, as has often been emphasized, is a most undesirable character on account of its bad effect on the appearance of cloth, especially if dyed; there is likely to be little sale for neppy yarns, however strong they may be. The other factors are generally of less importance, except that great irregularity of yarn is very undesirable, and, where it exists, is an indication that the cotton is not suitable for so high a count.

(7) *Spinning Breaks* indicate the frequency of breakages during the spinning. Breakages may be due to random causes other than spinning quality, so that small differences are not significant, the standard error of the observation being equal to the square root of the number of breaks; when the figure for breakages (per 100 spindles per hour) is about thirty or more for any given count, the cotton is not suitable for spinning in that count.

(8) *Winding Test.* In commercial practice warp yarn has generally to undergo some "winding" process after spinning, the yarn being wound on to "cheeses," "cones," or "bobbins" of much larger capacity than the ring bobbins or mule cops upon which it has been spun. In this process the breakages of comparatively infrequent weak places may be very troublesome and reduce production and the quality of the yarn. It is doubtful whether the lea test is a complete guide to the existence of such weak places, and this *ad hoc* test has therefore been devised. Some leas of the

yarn are wound at a constant tension—usually equal to the weight of 6 hanks of the same yarn (a hank=840 yards)—and the number of breaks noted. As in the figure for spinning breaks, the standard error is equal to the square root of the number of breaks observed.

Thus, in comparing spinning test results, the most important points to bear in mind are that the chief criterion of spinning value is the lea strength, subject to the qualifications that (i.) if the yarns are very neppy their commercial value is much depreciated; and (ii.) if for any count of yarn spinning breaks are numerous and/or the yarn very irregular, the cotton is only suitable for some lower counts. The ballistic test for "work of rupture" and the winding test are useful for deciding between yarns which are otherwise similar.

AGRICULTURE AS AN INDUSTRY

BY

SIR DANIEL HALL, K.C.B., F.R.S.

THOUGH agriculture is the most primitive of the industries, for it began when the wandering hunters or pastoralists fixed their abode for the season's cultivation, it is never regarded as one with the other industries, but as an occupation apart. The categories of agriculture, commerce, and the industries are adopted by the economist as by the man in the street.

This is because it has never shared, except to a very limited extent, the concentration which has become characteristic of the industries proper, ever since the power factory began to swallow up the home crafts and domestic workshops. Broadly speaking, the food production of the world is done on peasant farms, worked by one man and his family, with perhaps a little extra labour at harvest. The size of the holding thus occupied may vary very greatly. In the wheat-belt of Australia the one-man farm may be 1,000 acres, in the Middle West the typical holding is a quarter block of 160 acres. In Europe, on fair cultivable land farms of 10 to 20 acres are very general. The extreme cases are met with in China, Japan, and India, where the holding may be no more than 2 acres, but is still the sole support of the family. In parts of China may be found densities of rural population up to 3,000 per square mile, of whom 90 per cent. may be engaged in the cultivation of the land.* As a general correlation, one may say that the output per acre increases as the holding gets smaller, but the output per man increases with the size of the holding. (See Price Howel, *J. R. Ag. Soc.*, 1922.) The single-handed Australian wheat-grower will produce up to 3,000 bushels per season; good English production, apart from recent examples of power farming, will average about 1,200 bushels per man employed.

Almost as a necessary corollary, it follows that the greater the subdivision of the land in a self-supporting community the greater will be the proportion of its population engaged in cultivating the land. One can contrast the position in parts of China mentioned above with France, which before the war was almost self-supplying as regards food and had about one-half of her population on the land. In Great Britain only about one-tenth of the population are employed in agriculture, but less than half the food the country consumes is produced there. As farming is now being conducted in Western countries, about 2¾ acres of land is cultivated to produce the food and other agricultural products required by one unit of the population (*v.* Hall, Presidential Address, Agriculture, British Association, 1926).

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* "The population of the large island of Chungming in the mouth of the Yangtse River, having an area of 270 square miles, possessed, according to the official census of 1902, a density of 3,700 per square mile, and yet there was but one large city on the island; hence the population is largely rural."—KING: *Farmers of Forty Centuries.*

In Great Britain there has been from comparatively early times a drift away from peasant farming towards a capitalist system, with a master and labourers receiving a weekly wage. In the older farming of at least the East, Midlands, and South of England, the land was laid out in open arable fields subdivided into acre strips. Each field carried the same crop on all the strips; there would be, for example, a field of wheat, another for barley or beans, and a third in fallow. Turnips and other fodder crops were unknown, the livestock pastured on common grazings and the waste of the manor, and on the arable land after harvest. Each tenant of the manor had a certain number of strips, more or less scattered, in each field; these he cultivated himself and took the produce of. Enclosure—the division of these common fields into separate holdings and private ownership—began in Tudor times because the high prices of wool, then the staple export of England, tempted men to exchange cultivation for sheep-grazing. The process of enclosure went on apace in the seventeenth, eighteenth, and early nineteenth century, because the growth of commerce and industry made demands for food which could only be satisfied by the improved cultivation of the land that was possible with enclosed fields. A few examples of unenclosed land still survive—*e.g.*, Laxton, Northamptonshire, and the Isle of Axholm; and on the heavy clay pastures of the Midlands one can still see the ridges and furrows of the old common fields.

The output from the land must at least have doubled as a result of the new farming that came in with the enclosures. At the same time the small peasant holdings began to be put together into larger farms. The unsuccessful peasants mortgaged their holdings in bad seasons and had to part with their land. They either sank into rural labourers or got away to the growing industries and commerce. In England from Tudor times there were always openings for men in other occupations than farming, and a continued drift from the land in consequence. We can see the results of this slow "rationalization " of our farming in the present distribution of the land; in 1924 exactly two-thirds of the cultivated area of England and Wales was held in farms of 100 acres and upwards. These larger farms employed on the average 2¾ men per 100 acres, so that if we take the typical English farm as one of 300 acres, the enterprise would be a case of one master and eight labourers. Such a distribution of the land into common fields divided into strips was probably general throughout the greater part of Northern Europe. The organization of farming into larger units has advanced more in Great Britain than in other countries, but the capitalist holding with wage-earning labourers is to be found in all the western European countries, though, except perhaps in southern Sweden, it is not the typical form of land holding. Really large-scale farms organized on an industrial basis are rare. There are great " domain " exploitations among the large landowners of East Prussia, but the similar estate farms of Poland, Czecho-Slovakia, Rumania, etc., have to a large extent been divided in response to agrarian unrest during the war. In Great Britain there are a few men in control of considerable areas, up to 12,000 acres, but as a rule the farms thus constituting a single business still appear as separate holdings in the Agricultural Returns, and are managed individually, only the buying and selling are centralized. It is only in some of the plantation industries—sugar, rubber, cotton, tea, and coffee, etc.—and again in certain forms of market gardening in this country and America, that anything comparable to factory organization can be found. In Russia the five years' plan for agriculture aims at replacing the old peasant cultivation in small units by extensive industrialized exploitations, but while it is clear that great advances in production have been realized, information is as yet unavailable as to the financial results or the stability of the experiment. It is noteworthy that the joint-stock enterprise is very rarely to be found engaged in general farming, and agriculture is thus cut off from the normal source of capital. In Great Britain farming is financed by private capitalists, assisted by bank overdrafts and credit from dealers, though, of course, under our renting system the landlord carries the bulk of the fixed capital.

Certain consequences follow from this predominance of the family farm in the business of food production. The individuals are weak commercial units. In so far as the products are not sold direct to consumers (*e.g.*, the milk supplies to northern English towns, where the producer also has a round and sells from his cart), and have to enter the general stream of commerce for distant transport and export, there springs up a loose organization of dealers who collect the small parcels, grade and bulk them. The producers are powerless against the dealers, who pay no more than will serve to keep the farmers in being. To some extent this dependence upon the dealers has been relieved by co-operation among the farmers, but co-operation is slow of growth, and has proved easy of organization only when the producers are working for an export market. Nor does co-operation remove the mechanical disadvantages of the small farm, its inadaptability to the use of power machinery and the economic organization of labour. Where the land is much divided it becomes difficult to carry out extensive schemes of land improvement such as drainage, of which the collective advantage may be great, though the individual advantage may be unequal and deferred. The strength of the peasant system lies in the willingness of the occupiers to work long hours, in the unpaid labour of the other members of the family, and in the scope it gives for individual contrivance and economy. But even this latter virtue is discounted by the fact that peasant farmers regarded as managers of a business are unselected and constitute a random slice of the community, whereas the manager of an industrial enterprise is a man picked for his directive ability. The average performance of a group of peasant farms must therefore be low, even as the average character or intelligence of any random group of men is low. Peasant farming is inevitably highly conservative, dominated by traditional practice, and but slowly receptive of new knowledge or scientific method. Indeed, as compared with the great industries, peasant farming affords little scope for the application of scientific research. New fertilizers or improved varieties produced by the plant-breeder can readily be demonstrated to the farmers, and will be adopted by degrees according to the intensity of the propaganda. But changes in the system of farming are less capable of demonstration, and often the results of scientific investigation require a prolonged period of working out before the laboratory conclusions lead to a practical process. This intermediary stage is normal in factory enterprise, but is quite impracticable in a system of small units. To take an example, genetic science indicates the way to considerable improvements in the breeding of live stock, but the experimentation and selection would require work on thousands of animals over a period of years. There is under the existing system of farming no possibility of financing the preliminary work nor of being repaid for success. The only method by which the peasant farms can be linked up to a large directed enterprise is to tie them to the processing factory, and make them work to a schedule.

One may sum up the situation by saying that peasant farming is a mode of living rather than a business for profit, and that the food, etc., on which the urban population depends are little more than the by-products of the peasants' activities.

Broad considerations of economy of man-power must exert pressure in the direction of building up large farms on which the cheapening of production would be effective and would make profits. But farming is still so much of a "mystery" that the capitalist has always been shy of venturing into it, and the cutting of prices to which the peasants are subject keeps wholesale prices down until the margin of profit to tempt the capitalist into the business is less than might be expected. In this country, again, skilled managers capable of handling a 10,000-acre unit would be hard to find, because there has been no opportunity for obtaining experience of the kind. A man may be an excellent manager of even 1,000 acres which he can keep under his own eye, and yet lack the organizing ability to deal with ten times that area. Of this failure examples are not lacking. Nor under existing conditions would it be easy to obtain blocks of land suited to such a purpose. English land is still subdivided into a number of ownerships, many of them held for non-economic reasons. On any estate the woodlands, shaws, and spinneys are numerous, and though producing little in the way of timber, are valued for game, and would have to be purchased at an uneconomic price. An estate managed for production would want to remove both them and the hedgerows, but the capital expenditure would be relatively excessive, and would only slowly give returns. In other parts of Europe where the land is still more subdivided and where peasant ownership is general, the obstacles to the creation of large farming units are far greater; any general movement in that direction would create a social upheaval. So far from adopting a policy of the kind, however consistent with a planned national economy, continental nations are in general committed to the preservation of peasant farming by means of protective duties to maintain prices and obviate the competition of the newer countries with extensive cheap production. In France, at the moment of writing, the wheat growers are demanding Governmental aid, and organizing themselves to withhold wheat from the market because the price has fallen to 120 f. per quintal. This is equivalent to 14s. per cwt., the world price being 6s. to 7s. per cwt. in Europe, and the price that is being guaranteed to English farmers by legislation being 10s. per cwt. In Czecho-Slovakia the internal price of sugar from beet is being maintained at about three times the price at which the surplus (nearly one-half of the production) is being sold in the world market, largely to Great Britain.* Of course, duties also enter into the internal price of sugar, but the fundamental fact is that the Government dare not abandon the peasants to the play of the open market, and sugar beet is an essential feature in their cultivation.

No citizen, rural or urban, but has to reflect upon these matters. An adequate food supply is the basis of civilization, and every state has to consider how to maintain it. Even in easier times than the present world depression the complaints of the farmers about inadequate returns are general in every country; it is necessary that their position should be one of reasonable prosperity, because their demand for commodities really sets the ball of trade rolling. We may dismiss the idea of over-production, save as a temporary and local affair. The demand upon the farmer is almost infinitely elastic; not that the consumers can eat more, but because with every expansion of income the demand shifts to better types of food which call for more labour in their production. The present Orientals would like to exchange rice for wheat, just as the Baltic peasant would forego rye if he could afford wheat; a very large proportion of the working classes of all countries live mainly upon cereals, and wish to increase the meat and milk in their dietaries; the English housewives buy more vegetables and fruit as wages increase.

During the last sixty years the wages of the British working classes have been steadily rising, at the same time the prices of the prime food commodities were equally falling, and again are approaching the pre-war levels. But the response has not been so much a reduction in the gross expenditure of the family upon food as a demand for kinds of food that were previously beyond the income available to large classes of the community. The average consumption of meat and milk has increased, still more have vegetables and fruit, hitherto almost luxuries, become part of the dietary of all classes. In the farming of the country these changes are reflected in the increased production of live-stock products at the expense of cereals, and in the growth of market gardening and fruit production (see the *Agricultural Output of England and Wales*, 1925, Cmd. 2815). Apart from increases of population, the demand upon production from the land is increased rather than diminished by this alteration in the standard of living. As the collective demand shifts from cereals to meat and the corresponding shift in relative prices induces farmers to convert their cereals into meat, the total draught from the land is increased, because the gross nutritive power of the meat is much less than that of the cereals from which it was manufactured. In an ordered national economy, if such a thing is feasible, in a state organized for efficiency like an engineer's layout, there is a clear gain of man-power when as small a proportion as possible of the population is engaged in the prime business of producing the food the community requires. Probably 10 per cent. of the population could do this under organization, and yet maintain the existing standard of living. But the vision of an ordered world is very far away; at present most statesmen in the world are intent upon preserving the peasant population and on maintaining, if not increasing, the number of men living on the land. The peasant population constitutes a stable element in the community, one that is socially valuable in many ways. A peasant population, even the old rural communities which have so very largely perished in Great Britain, has a social organization, a " culture " of its own which very few people wish to exchange for the amorphous aggregates of wage-earners characteristic of the great industrial towns. So the small farm is protected even at the cost of dearer food for the rest of the community. The alternative of a reconstruction of the land system is too gigantic a task for any statesman to contemplate; few people care to contemplate social revolution on Russian lines.

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* In 1930 the wholesale price of white sugar in London ex duty was 12s. per cwt. —1·3d. per lb. The retail price, duty paid, was 2½d. per lb.; the corresponding retail price in Czecho-Slovakia was 4¼d. See Report of the Sugar Beet Industry, Ministry of Agriculture Economic Series, No. 27.

But ultimate economy of production lies with the large organized farm, and economic pressure ultimately and, however slowly, has its way. In the past it has transformed the mediæval land system of England with its open fields and common farming into private ownership and agricultural units of moderate size. It is not to be supposed that such change is at an end, but it may be presumed that as it arises in response to economic pressure it will be a gradual transformation, without sudden dislocation or hardship to any considerable section of the people. Political action may at times accelerate and at times delay, but the course of English history leads one to anticipate that it will do little more than register the changes that have already taken place in men's opinions and mode of living.

BLACKARM IN THE GEZIRA, SEASON 1931-32

BY

R. HEWISON

The season was generally favourable to the growth and development of the cotton crop in the Gezira, a yield of over 4 kantars per feddan being obtained on a total area of 194,978 feddans. Both the quality of the lint and the ginning out-turn, moreover, were satisfactory, and confidence in the capacity of the Gezira to produce a good yield of high-grade cotton has been restored, even in those quarters where the poor results of the previous two years had induced the most pessimistic views. This result is due to a return of climatic conditions more characteristic of the Gezira area, and more generally favourable to the growth of the cotton plant, and to a reduction of the loss caused by certain plant diseases, particularly Blackarm and Leaf Curl.

In spite, however, of the improved conditions, a serious attack of Blackarm occurred, breaking out rather late in the season. The infection was widespread, and only one block in the whole irrigated area escaped entirely. Where conditions were favourable to the rapid development of the disease, as in the central blocks, the damage done was very much on the same scale as in recent years. Large areas of what promised to be very good cotton suffered to an extent which reduced the final yield by anything from 30 to 60 per cent. In other parts conditions less favourable to Blackarm prevailed, and large areas of cotton, on which infection was observed, seemed to throw off the disease, the apparent damage being much less.

It is always difficult to arrive at a satisfactory estimate of the loss caused by Blackarm. Much of the damage sustained by the plants, particularly in the early stages of development, is only apparent when very close and regular observations are made. The area in which infection was observed and noted amounted to about 100,000 feddans, of which some 35,000 feddans were heavily infected, and suffered serious damage. The reduction in yield directly due to Blackarm could not be put at less than 60,000 kantars of cotton; it is doubtful, in fact, whether 100,000 kantars would cover the loss.

The experience of this season has shown clearly that our knowledge of Blackarm, and particularly of the means by which it is carried over from one season to another, of the mechanism of its spread, and of the factors which influence the rate and extent of its development in the plant, is definitely lacking, and far from sufficient to enable any real control of the disease to be effected. In the following notes an attempt is made to bring forward certain facts which, in the writer's opinion, appear to have a bearing on the problem. Some of the views expressed are personal opinions, based on observations of the occurrence and development of the disease in various parts of the Gezira. While they are admittedly not as yet all supported by scientific experiments, they are not, as far as can be seen, in opposition to ascertained scientific facts. If further investigation of the points raised serves to throw more light on the serious problem of Blackarm control in the Gezira, something useful will have been accomplished, whether these particular views are confirmed or not.

Rainfall.—Since the connection between the annual rains and the incidence of Blackarm seems to be established, some discussion of the extent and distribution of the season's rains is necessary. Generally throughout the irrigated Gezira the rains were below average. At the Gezira Research Farm the total fall for the season amounted to 336·4 mm. against an average of 405·9 mm. Throughout the Gezira only three blocks recorded rainfall in excess of average. Very little rain fell in May and June. In July 111·7 mm. were registered at the Gezira Research Farm against an average for that month of 128·6 mm. August rainfall was 107·7 mm., the average being 163·3 mm. September's total was 89·3 mm., with an average of 65·8 mm. In October 28·3 mm. were recorded, against an average of 6·4 mm. Thus, while May, June, and August were well below, and July slightly below, average, September and October were well above it. Generally over the Gezira the rains occurred in several fairly well-defined periods. The connection between certain of these and the incidence of Blackarm will be referred to at a later point.

Sowing.—About 88 per cent. of the total cotton area was sown between August 10 and 31. Sowing was commenced at a later date than usual for two reasons: (1) Very early cotton—*i.e.*, with sowing dates in late July and early August—has been found to be particularly liable to serious Blackarm damage; (2) to allow time for the eradication of infected volunteer seedlings on the previous season's cotton land.

The whole area was sown with seed newly imported from Egypt, considered to be practically, if not entirely, free of Blackarm infection. As a further precaution against Blackarm it was all treated with Abavit B, a proprietary germicidal powder. All land was thoroughly irrigated, and the seed was not put into the ground until all excess of moisture had been got rid of and the surface soil had warmed up. Sowing, on the whole, was well done, and germination was good, wherever the seed was put in deep enough. An excellent stand generally was obtained, and development of the seedling plants was very satisfactory.

Occurrence of Blackarm.—In the case of the treated Egyptian seed no case of primary infection—*i.e.*, infection on the cotyledons—was observed. No secondary infection was detected until about September 18, when the disease was found in a low-lying area in the Abdel Hakam block. During the succeeding week the occurrence of the disease was confirmed over a considerable area and at widely separated points.

In the case of the first few outbreaks the cotton plants on the infected areas were completely cut out and destroyed, with a view to preventing further spread of the disease, but these attempts appeared to have no effect. Where conditions were favourable to the development of Blackarm, cotton adjacent to the cut-out areas contracted the disease. Its occurrence and development on such cotton were progressive, and appeared to be related to some previous general infection rather than to any spread of the disease from those plants upon which it was first observed; in fact, throughout the season the spread of infection from diseased plants in a plot was found to be much less rapid and extensive than theories previously held would appear to indicate.

The rapid increase often observed, and described as a lightning spread of infection from the earliest infected plants, is probably due much more frequently to a progressive activation of the causal organism, *Bacterium malvacearum*, which had been widely distributed over the area in infective material before—and often long before—any active signs of the disease were observable. Confusion of thought on this point may account, to some extent, for the failure of certain measures of control which have been recommended from time to time and put into operation. There can be no doubt that under certain conditions the disease is spread from plant to plant. In fact, it would be remarkable if this were not so, considering how closely they are spaced, and how easy it must be for the organism to be carried by wind, rain, or insects, from an infected plant to its immediate neighbours. Observations during this season, however, indicate that where a general outbreak of the disease occurred, it was not due to a spread from isolated plants, or groups of plants, infected at some earlier period.

In the writer's opinion such outbreaks were caused, as stated above, by the more or less simultaneous activation of the organism responsible, which, previously spread over a wide area, was, in an inactive condition, already in contact with the cotton plants, or in such a position relative to them as to make contact an easy matter.

The conditions necessary for the activation and rapid increase of this organism would appear to be fairly well established. An excess, or at any rate a sufficiency, of moisture is a first essential. Recent work has shown that temperature is less of a controlling factor than was at one time assumed, but the rate of development appears to be greatest within certain ranges. Successful development is, moreover, dependent upon access to the tissues of the host plant. Provided, then, that organisms in an inactive condition are in contact with any part of a cotton plant, the occurrence of heavy rain-storms in the Gezira, by supplying the moisture necessary and exercising a cooling effect on the air and soil, would create the conditions needed for their activation and subsequent rapid increase.

Both Archibald and Massey have proved that *B. malvacearum* is capable of persisting in a dry form for a considerable period, although its capacity for rapid increase is dependent upon excess of moisture. Its presence in the dry débris of cotton fields has also been demonstrated. Much of this débris must in due course be broken up into fine dust, and in this form be easily transportable by any wind that blows. Where winds and dust are such a feature as they are in the Gezira, it would appear natural, therefore, to fear a dry spread of infective material throughout the area. Recent work by Archibald has shown that the disease can be induced in a healthy plant by scattering dry dust containing infective material upon its leaves, provided these are kept sufficiently moist. He has also recovered the organism from dust washed from leaves collected in the field from apparently healthy plants.

It is interesting to note that, for this season at any rate, there was no question of Blackarm being confined to, or more prevalent on, the poorer land, or cotton whose vitality had been reduced by other causes; in fact, the most serious and persistent attacks occurred on some of the finest and best-grown cotton in the Gezira.

Special Observations.—In order to obtain as much information as possible regarding the incidence of the disease and possible sources of infection, an organized inspection of the whole cotton area was undertaken in November. Each Inspector made a careful examination of every field in his area, and submitted a report giving information on certain points. These reports have been studied, and data obtained from them analyzed in various ways.

Several points emerged, of which the following appear to be the most interesting:

1. The importance of the previous season's cotton land as a source of secondary infection.
2. The relation of rainfall to Blackarm damage.
3. The connection between dates of sowing and the development of the disease.

1. INFECTION FROM THE PREVIOUS SEASON'S COTTON LAND.

Of 1,457 numbers (*i.e.*, fields of 70 to 100 feddans) on which disease was observed, 1,140, or 78·2 per cent., showed the heaviest infection on the side next to the previous year's cotton.

In 133 cases, 9·1 per cent., infection was reported to be heaviest on the opposite side.

In 184 cases, 12·7 per cent., no distinction could be made.

The percentage of cases in which it was impossible to say on which side the infection was heaviest was much greater where the Abu Ishreens,* and consequently the long sides of the cotton areas, ran nearly north and south—*i.e.*, in a direction parallel to the prevailing winds—than when they lay more or less at a right angle—*i.e.*, east and west. In the Habbob† season, and during the rains, occasional storms may blow from almost any point of the compass, but for the greater part of the year the winds are normally from either a northerly or a southerly direction. Any deviation from their normal steady course is more frequently from the east than from the west. All the evidence available convicts the old cotton areas as a chief source of secondary infection, and the data discussed above would appear to support, if not to confirm, the view that much of the infective material is transported in a dry form by the wind from the old cotton land to the new.

There are at least two forms in which it is considered that infection from such areas could be carried.

(*a*) Volunteer seedlings, already referred to, if diseased, are a possible source of secondary infection, and have been regarded by some as the main, if not the only, source. This belief was based on the assumption that during, and possibly after, the occurrence of rain-storms in the Gezira, which are generally accompanied by a driving wind, organisms from the leaves of these volunteer seedlings

* Main canals. † Dust-storm season.

were carried forward by raindrops, or by the spray which forms when the rain strikes the ground, and which in a strong wind may drift for some way. It is possible that organisms may be distributed in this manner, but when it is considered that at the critical period the volunteer seedlings are only a few inches high, and frequently surrounded and overtopped by a dense growth of weeds and grass, it is difficult to understand how raindrops, or spray, could carry infection picked up so near the ground for more than a very limited distance.

There appears to be no scientific evidence on this point, and it is suggested that experiments should be designed to ascertain whether, and to what extent, transmission in this way is really possible.

(*b*) The other chief source of possible infection—*i.e.*, the débris from diseased plants of the previous cotton season—has already been referred to. That such material is definitely infective for a period not yet determined, and that it is capable of producing the disease if dusted on the leaves of healthy plants under suitable conditions of moisture and temperature, would appear to be established. That infected dust could be carried for considerable distances by the wind cannot be doubted by anyone with experience of the Gezira. Conditions make it possible for this movement of infective material to go on throughout the year, excepting for intervals of varying length during the rains. It probably becomes intensified, however, when the cotton crop is cut out, and the débris lying on the old cotton fields is exposed to the uninterrupted force of the wind. The new cotton land, therefore, has every chance of being infected long before the sowing season arrives.

As a result of recent work it is claimed that the organism is destroyed, or its vitality greatly reduced, by prolonged contact with irrigation water or wet soil. Further research is necessary before this point and its practical significance can be definitely established. All land in the Gezira is given a heavy watering before cotton is sown. That infection previously brought on to the cotton plots is not all rendered innocuous by the heavy pre-watering would be accounted for by the impossibility of complete inundation of every part of the fields.

2. THE RELATION OF RAINFALL TO BLACKARM DAMAGE.

The connection between rainfall and the degree and extent of Blackarm infection has been recognized in the past. This season's observations have confirmed this general connection, and have also provided data from which it has been possible to attempt a closer estimate of this relation. Rainfall records are now available from over a hundred stations in the irrigated Gezira. Examination of these shows the following general relations between the amount of rainfall and the extent and degree of Blackarm infection:

1. Other factors being similar, the areas receiving the heaviest rainfalls after sowing generally suffered most from Blackarm.
2. Four of the stations around which the most serious damage has been done are included in the eight highest rainfalls.
3. With their rainfall records arranged in descending sequence from the highest, the thirty-five stations at the top of the list covered the whole of the areas upon which serious loss of crop from Blackarm occurred, with one exception.
4. Serious Blackarm attack was practically confined to areas on which more than 100 mm. of rain were recorded after sowing commenced.
5. Actual infection occurred with much lower rainfalls than was expected. In certain cases a considerable and widely spread infection was observed with a total rainfall during the critical period of not more than 50 mm. Such infections, however, did not develop to any serious extent.

3. The Connection between Dates of Sowing and the Development of the Disease.

Although no infection was observed that could be directly associated with the rains which occurred very generally on August 21 and 22, examination of the records shows that some connection exists. In certain areas, and notably on some of those receiving the heaviest falls on these dates, it was found that where sowing took place before this rain occurred, infection was general and heavy; while, on the other hand, cotton sown quite soon after—some of it as early as August 25—showed little or no disease, and early September sowings escaped infection in almost every case. This point is interesting in view of the fact that Blackarm was not detected anywhere until September 18, and its occurrence then appeared to be more definitely connected with the wet periods September 2 and 4 and September 10 to 15.

In addition to the general conditions discussed above, there are certain points to which more particular reference should be made.

(a) EFFICIENCY OF ABAVIT B TREATMENT OF SEED.

Conditions during the period of germination of most of the seed sown were such that it was impossible to say to what extent, if any, the general absence of primary infection was due to this treatment.

(b) RESTRICTED WATERING.

It had been considered that some control of the development and spread of the disease might be effected by lengthening the intervals between waterings, so as to induce drier conditions around the plants.

An experiment designed for the purpose of testing the effect of various intervals between waterings, was carried out by Dr. Greene on well-drained land. The earlier waterings were given at intervals of fifteen, thirty, forty-five, and sixty days. The whole area under experiment contracted Blackarm, and no difference in the degree of infection could be observed between the various intervals between waterings.

SUMMARY.

1. Climatic conditions were generally favourable to the early development of the cotton plant. Rains during the sowing period were generally below, while those of September and October were above, the average.
2. Newly imported Egyptian seed treated with Abavit B was sown throughout the Gezira, except on one small area.
3. No primary infection was observed where such seed was used.
4. Serious Blackarm damage resulted from secondary infection in various areas, the results of which were first observed on September 18.
5. This does not confirm the opinion expressed by Massey (EMPIRE COTTON GROWING REVIEW, July, 1931, p. 207): " It would appear from the foregoing that, as far as Blackarm is concerned, the fate of the crop is decided during the period of the germination of the seed."
6. All evidence available indicates that the previous season's cotton land is the main source of secondary infection.
7. Such infection might derive from (a) diseased volunteer seedlings, (b) débris of diseased plants of the previous season's growth.
8. It is considered that the transmission of infection by rain has very definite limitations, but that dry infective material could be carried for considerable distances and spread over wide areas by the wind.

9. The infectivity of débris from diseased plants has been established by experiment.

10. It is considered that, carried by wind and brought into contact with healthy plants, the organism could be activated by the conditions produced by such rain-storms as occur frequently in the Gezira.

11. It has been claimed that sustained contact with irrigation water or wet soil destroys the organism, or reduces its vitality to such an extent as to render it innocuous.

12. That the heavy watering given to all cotton land before sowing should fail to destroy all organisms carried by wind or other agencies on to the soil might be explained by the fact that a complete submergence of every part of a field is not possible in practice.

13. Reinfection of areas on which the destruction had been complete would, however, be possible in the dry periods which occur during the rains when a steady south wind prevails.

14. The general connection believed to exist between the amount of rainfall and the extent of Blackarm infection is confirmed by this season's observations.

15. The connection between the date of sowing and the incidence of the disease has been investigated. Cotton in certain areas sown before, or at the time of, rains which occurred on August 21 and 22 was found to be generally and heavily infected. Plants resulting from sowings a few days later showed little disease, while September sowings in most cases escaped entirely.

16. Rains in September and October are regarded as having exercised a controlling influence on the development of the disease, while some unexplained connection appears to exist between the extent of early infection and heavy rains late in August.

17. The efficiency of treatment with Abavit B was not really tested, since conditions generally were against primary infection. The effect, therefore, of this treatment in the Gezira still requires confirmation.

18. Experiments conducted with another aim showed that lengthening the intervals between waterings appeared to have no effect on the development of the disease.

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THE ACCLIMATIZATION OF COTTONS IN NEW AREAS

BY

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SINCE the rediscovery of Mendel's law, there has been an enormous increase in our knowledge of the hereditary mechanism in both plants and animals. According to modern genetics a given organism owes its structure and attributes to the activities of about 5,000 or more genes, each of which is probably somewhat larger than a hemoglobin molecule, and which are contained in linear arrangement in a certain number of rod-like bodies called chromosomes. Each organism possesses a definite number of chromosomes in its body cells, but this number is double that of the germ cells. The process by which the chromosomes become halved in number is known as the reduction division. This is described in text-books and need not be further considered here.

In the last few thousand years man has succeeded in modifying several wild species of cotton in order to adapt them to his needs. We now have two great groups of cultivated cottons indigenous to the New and Old Worlds respectively. These two groups differ in chromosome number, the New World types possessing twenty-six pairs of chromosomes and the Old World types thirteen pairs. The original prototypes of these cottons may in some cases be found growing wild, and we can study the results of the modifications arising from the selection process carried out by man. If we examine some true wild cottons such as *G. tomentosum* and *G. taitense* in the New World group, and *G. obtusifolium* var. *transvaalensis* in the Asiatic group, we are struck by the fact that the staple is useless for spinning purposes, being too short and coarse. The wild types are all perennial with small bolls, of which up to 500 may be required to make a pound of seed cotton. An Upland type is known in which the size of the boll has been increased so much by selection, that less than forty bolls are required to make a pound of seed cotton. The wild types have a staple length of less than ½ inch, whereas the modern Sea Island Superfine cottons possess a lint length of 2½ inches. All these changes have been accomplished by selection, which means that man has sought, uncovered and isolated certain gene combinations advantageous to himself, but not necessarily fitting the plant for existence in a wild state.

Nature isolates gene combinations important only in the struggle for existence. The planter requires an association of genes which will produce a large quantity of cellulose in the form of lint hairs with certain definite properties. Such an association of genes is a very complex affair. The planter wants genes also for ensuring rapid and quick germination of seed, for resistance to certain diseases, for early flowering, rapid fruiting, etc. In addition to these, he wants gene combinations which will render the plant capable of thriving under a certain specialized set of bio-climatic conditions. All these changes mean that the genetic constitution of the original wild population has been modified by selection and re-combination to an enormous extent. Many genes which were very rare and scattered in the wild population have probably become predominant in the cultivated types, and such genes as that for brown lint—universally prevalent in the wild state—have become almost completely eliminated from cultivated populations. From a genetic point of view, the change has been one from a population of great diversity in which a large number of genes were present in a two-phase condition, to a population which has probably lost one of the phases of a large number of genes.

If, therefore, attempts are made to acclimatize cottons in new bio-climatic areas, the genetic composition of the introduced types needs careful consideration. American Upland may be considered in this connection.

American Upland in its evolutionary history has become profoundly modified in its genetic constitution, and has acquired a set of genes which render it adapted to the climatic conditions of the southern states of America. It is thus unlikely that its introduction into the Tropics would be attended by much success. It is probable that the very combinations of genes which render it suitable for the Southern States may render it unsuitable for the different climatic conditions of the Tropics. For the last sixty or more years, attempts have been made to introduce Upland cotton into various parts of tropical Africa. The history of such introductions is one, on the whole, of failure. The writer is at present not able to recollect a single case of success in the introduction of any modern standard variety of Upland cotton into Africa. There are cases where moderate success has been obtained, such as with the variety "Over-the-Top" in Nyasaland. There are also some cases in which a form of Upland has become a standard cotton in certain districts. We have for example U4 in South Africa, Allen Long Staple in Nigeria, and Nyasaland Upland in Nyasaland. These apparently constitute exceptions, but a close survey of material leads to some interesting conclusions.

1. The commercial cotton U4 is markedly different from typical Uplands. It has the staminal arrangement characteristic of Bourbon (the semi-wild tropical perennial) rather than Upland, and the pollen is more frequently yellow than cream, a characteristic not only of Bourbon, but also of the undifferentiated Uplands of Central America. Genetically it has all the signs of being either a more primitive type of Upland than the modern American ones, or else of being descended from an Upland-Bourbon cross.

2. Punjab-American is a form of Upland somewhat acclimatized to North-west Indian conditions. Modern Uplands are apparently unable to acclimatize themselves. Why is this ? Probably because at the time when the Punjab stock came to India, the Upland cotton in the Southern States had a good deal more genetic diversity than it has at present, and thus possessed the genes necessary for acclimatization to Indian conditions. In this connection it is worth while noting that Punjab-American is said to resemble closely the Petit Gulf cotton of New Orleans, common 100 years ago.

3. The non-adaptability of modern Uplands to tropical African conditions is almost certainly due to the fact that the genes which would have been picked out by natural selection for survival in Africa have been either eliminated or rendered extremely rare by the ecological conditions of the Southern States. It is clear that this must be so, since semi-wild Bourbons morphologically resembling Upland very closely are found in various parts of West Africa more or less perfectly adapted to the ecological conditions. It is clear that a cross between a desirable form of Upland and a wild West African Bourbon will possess all the genetic combinations necessary for West African conditions. Similarly crosses between the acclimatized Ishan cotton of Nigeria and Sea Island or Egyptian should contain some very desirable genetic combinations.

The lessons which genetics can teach us about the introduction of new cottons into a given ecological area may be summarized in the form of a series of statements embodying certain recommendations as to procedure. These are as follows:

1. Cottons from bio-climatic areas markedly different will not, unless they are characterized by very great genetic diversity, possess combinations of genes rendering them physiologically suitable for the new climate.

If the cotton is markedly heterogeneous on its first introduction, the required acclimatization genes may be present in the stock, but be scattered, some in one plant, some in another. Isolation of the most promising types in the form of pure lines, then crossing these to produce more effective combinations, may ultimately give more or less perfect acclimatization, but the various factors might be so scattered that the task of sifting them all into one or two types would probably prove insuperable.

2. If the introduced cotton is a pure line, it may be either retained or rejected on its behaviour in the first year of introduction. Unless the climatic conditions in the new locality are nearly identical with those of the old, the chances are strongly in favour of failure. The case of the introduction of West Indian Sea Island cotton into Fiji is an example of successful introduction into a closely similar bio-climatic area.

3. It follows from (2) that cottons intended for a new area should possess as many physiological genes as possible in a heterozygous condition. If there is a wild cotton in the country of Bourbon type, it will provide all the physiological genes necessary for crosses with various standard Uplands.

4. After making a cross of indigenous wild Bourbon by Upland, the F_1 can be selfed to produce an F_2. This will give all possible combinations of physiological genes, and some of these may be much better than either of the two parents, since there may occur combinations of economic and the required physiological characters. On the whole, however, it is better to use the F_2 to create what is called a plant population. A plant population is obtained by selfing a large number of the best F_2 plants and growing a mixed lot of F_3. Similarly, a large number of desirable F_3 plants may be selfed, and the seed mixed to plant a large F_4. This process is carried on for several generations. With each successive generation of self-fertilization, the number of genes in a homozygous state becomes larger, until in five or six generations most of the combinations are pure or relatively so. In each generation there has been abundant opportunity for natural selection to eliminate the unsuitable and weak combinations. With this system there is no opportunity to select plants on account of hybrid vigour, a phenomenon which is very characteristic of interspecific crosses in cotton and also of crosses between types of somewhat diverse ancestry. After a number of generations to selfing, the field should consist of a mixture of pure, but markedly differing types, each capable of originating a pure line. A large number of these can be selected and grown under pedigree culture for agricultural trial.

5. The above method of creating plant populations is more particularly useful when it is desirable to synthesize the best qualities of two pure lines, both of which possess the requisite adaptability to the climatic conditions. An example of such an experiment might be to combine the lint length of one strain with the resistance to Angular Spot of another. In a cross between, say, wild Bourbon and Upland, the number of genetic differences would be so great and the number of undesirable combinations so preponderant, that it would be desirable to cross the F_1 with the parent contributing the desirable lint characters. Take, for example, the cross:

(Bourbon × Upland) × Upland.

The plants here have on the average 75 per cent. Upland genes and 25 per cent. Bourbon genes. Such a backcross might well be the starting-point of a plant population in which year by year the best of the physiological combinations can be selected, while still retaining desirable agricultural and commercial properties. Here it would be desirable to begin eliminating obviously worthless plants from the first backcross onwards. In special cases where relatively few acclimatization genes are required from the wild or indigenous parent, the best plants of the first backcross can be backcrossed to the Upland type again with subsequent selfing to create a plant population.

USEFUL COTTONS FOR THE CREATION OF PLANT POPULATIONS

As starting-points for the creation of new plant populations it may be suggested that the following cottons would be of great use. These have all been under examination and many have also been the subject of genetic investigation.

1. *G. Darwinii.*—The wild cotton from the Galapagos Islands, which is somewhat Bourbon-like in morphological characters and which imparts a great deal of vigour to Upland crosses.

2. *G. tomentosum.*—The wild cotton of Hawaii, useful for crossing with Upland when great drought resistance is required.

3. *G. taitense.*—The wild cotton of Polynesia. Resembles Bourbon; suitable for crossing with Upland.

4. *G. purpurascens.*—This cotton exists in a wild or semi-wild state in the West Indies, Central and South America, and West Africa. The present indications are that Upland cotton grown in the Tropics should have a strong dose of Bourbon. Probably the

two most valuable sub-types for crossing are Brazilian Moco and Gambia Native.

Of possible Peruvian types only three will be mentioned, since the question of acclimatizing Peruvian in the Tropics does not usually arise.

5. *Ishan* from Nigeria.
6. *Tanguis* from Peru.
7. *Gambia Peruvian.*

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A SOUTH AFRICAN FARMING CHRONICLE

[Being abstracts, with notes, from the diary of one John McMarr, farmer at Doornhoek; depicting something of his life and surroundings, but with no attempt at chronological accuracy.]

BY

W. L. FIELDING, B.Sc.

The strip of country which has become known as South Africa's cotton belt lies immediately to the east of the Drakensberg Mountains. About 50 to 60 miles in breadth, it extends from the Zoutspanberg Mountains (Lat. 23°) some 400 miles southward to the Tugela River (Lat. 29°).

In South Africa the future of the cotton industry must depend primarily on the white settler. The following is intended as an immediate glimpse into the life and surroundings of such a farmer as one might meet living on the borders of the Low Veld, near the centre of the potential cotton belt mentioned above.

Although his surroundings and everyday life are typical of those of his class, in the character of John McMarr of Doornhoek a husbandman of rather sounder type perhaps than some of his fellows is purposely depicted. Neither a consecutive history of McMarr's life, nor of the development of cotton-growing is intended, but outstanding happenings and facts as they affect the welfare of Doornhoek and its owner's pocket are rather aimed at.

Hailing from old Scotch farming stock, John emigrated in his early twenties and spent many years pursuing various occupations in different parts of the Union, serving in spasmodic African campaigns in the late war. He led on the whole a discontented life, and soon after the war the farming spirit bred in his bones led him to go in search of a place where he could settle down and practise the art which had been his family's pursuit for generations.

A friend had a leasehold of a property in the Eastern Transvaal, just to the east of the Drakensberg, at an elevation of rather over 2,000 feet. It was winter, the dry season, when John journeyed down with his wife to see Doornhoek. Here we may turn to his diary, which John assiduously dictated every night of his life, the while his devoted wife recorded the chronicles in neat Victorian handwriting.

> ". . . We have travelled by train down the Johannesburg-Delagoa Bay railway, and at a little siding soon after Nelspruit were met by a Mr. X, travelling by mule buggy to the place Doornhoek, 6 miles from the rail. The day has been pleasantly warm, with a clear blue sky and the midday temperature about 70°. It is the dry season now and the red soil is parched. However, a small river runs through the place, and for some 100 yards on either side there appears to be a very fertile stretch of soil. The land lies in a small basin bounded by hills of 1,000 feet or so on the north and east, and low kopjes are on all sides. Doornhoek, or 'Thorn Corner,' is well wooded with mimosa or thorn bush, a feature which appeals to me, as we can sell the timber or burn it for charcoal, and thus help to cover our stumping and clearing costs."
>
> ". . . We are staying the night with Mr. X, who keeps a store, mostly for native trade, near the line, and we have decided to start work at once."

To one newly out from home a South African Low Veld farm seems a patchy business, a conglomeration of bits, twenty acres or so of tilled soil interspersed with irregular strips of virgin bushveld. It contrasts strangely with the consecutive, smooth succession of tilled land and pasture seen in temperate climates. But old McMarr was very observant and benefited by other people's mistakes in farming in a strange land. Although the farm he has ultimately created must seem strange to his home-conceived ideas, he has reaped the reward of his observation and foresight.

> ". . . Doornhoek is very up and down. We must keep to the flat places and avoid slopes as much as possible. Our rains will come in the form of heavy storms, and once the bush is cleared we should soon have bad washaways on the sloping bits with the fertile weathered soil lying in the dongas. Twenty acres are now cleared down by the river and we await the rains to start ploughing. In addition, I have cleared a small piece nearer the house, where my wife can grow a few vegetables and fruits such as paw-paw, mangoes and grenadillas. Also I have chosen three more pieces of 20 acres each on granite soil. They are reasonably flat and should grow cotton well."
>
> ". . . have got the charcoal-burning going well now, and managing to dispose of it at a price which will largely cover clearing costs. I am glad the lands I have chosen are well wooded."

There are many fundamental odds and ends to be seen to in the early days, and odd scraps in the diary give us an idea of how John spent his time.

> ". . . Two rooms of our house are now completed. The walls are of iron with deal matchboard linings, the roof of corrugated iron, and floors of deal boarding. It is necessarily of the simplest, and although raised from ground level on brick blocks I should not be surprised if later we were troubled with white ants and have to put in sounder concrete foundations. We can make our own 'dagga' bricks from the red soil here which dries out very hard indeed. We are using mosquito nets as the brutes are numerous, but later I shall build a mosquito proofed sleeping porch. This is fever country.
>
> ". . . I have bought 18 oxen and trek gear, the oxen at £7 apiece. They are a little lean now, but should fatten up when the veld improves with the rains. A wheelwright down the line has built me a useful wagon. It is busy now riding charcoal, and carrying things for the house from the siding.
>
> ". . . I have taken on 15 boys, mostly Swazis, and shall take more as I need them. Their wages will range from £1 to £2 per month with meal rations as well.
>
> ". . . Our house lies up under the hills. A creek runs down to the river some third of a mile away, and we have been busy building a small concrete dam and laying a pipe-line to the house.
>
> ". . . The days are warming up. It was 90° F. on the stoep to-day at midday. The rains should be here soon. Our first two-furrow mouldboard plough arrived to-day.
>
> "(*October*). Yesterday at midday, with the temperature at 98° F., great billowing white clouds appeared over the north-western horizon. Soon the white fringe was followed by a black mass building up in greater and greater intensity. By 4 o'clock rain was pelting down, the temperature dropping suddenly. Almost tropical rain kept on for two hours and then a lighter fall set in for the night. Our gauge, which I had sent from Johannesburg, registered 2½ inches this morning. We shall begin ploughing to-morrow.
>
> "(*November*). We have been planting to-day. Our double row planter worked well with two oxen, on the harrowed down ground. I have put in 20 acres or so of cotton, variety 'King,' on the granite above the river. On the rest of the farm I have

> put in mealies (maize), the big flat Hickory King sort. The wife has been planting out beans, 'brinjals' (egg fruit) and spinach in the garden; also some young paw-paw seedlings."

And so John McMarr got a start. As our purpose is to show something of the problems of his life we can only look at isolated bits in the diary showing up interesting episodes. Dates would serve little purpose here, but a few approximate indications are given.

> "(1920). Our cotton last year gave us just over 300 lbs. per acre. I have sold via——and Co., at over 2s. per lb., quite a good figure. The mealies, of which I held high hopes, produced few cobs of any size, though the plants looked healthy enough. They seem an uncertain crop. It will mean buying maize meal for the boys.
>
> ". . . While our cotton was on the ocean the price dropped to nearly half-figure. I had a letter from our agent to-day. I shall have to refund several hundred pounds on the advances he had made. The veld is very dry and our cattle are looking badly. The rain stopped earlier than in our first season. Although no records have been kept on the spot it is evident we have had a short rainy season. The creek is very dry compared with last year. We shall need heavy early rains if we are to get much ploughing and planting done before next Christmas. It is a heartbreaking business.
>
> "(*August*). Have spent a lot of time this winter building a sluice and putting up a water wheel down by the river. Have installed a small pump, which seems to work quite well by the wheel. It will give us a constant supply for the house, and help with the tobacco, with which I am determined to persevere this season. The snuff tobacco we grow here seems to be very popular with the natives. Our seedling beds are looking well.
>
> "(1921). Have put in quite a lot of Improved Bancroft cotton, and got quite a bit of tobacco planted out. Also a few mealies on the far part of the farm.
>
> "(*December*). Everything is looking well and we are full of hope. The new cotton seems a great improvement."

John had quite a good year then. It set him on his feet and during the following winter many plans for improving the house were carried out. New tobacco drying sheds went up built with gum-tree poles and reeds cut from the river bank. John wisely invested in new implements—a disc harrow, another plough, and more cultivators. From his diary one can see that the next season started well and hopes again ran high.

> " (*November*, 1922). With the hot weather and good rains the cotton is growing splendidly. I have 30 acres in. The tobacco down by the river is doing very well, especially the earlier planted irrigated lot. The pump, driven by the water wheel, works day and night, costs practically nothing to run, and is a sound investment.
>
> " . . . Don't know what to think about the cotton. It is very stunted and shrivelled and the leaves all red. I hear similar tales from several men in the district. They say that it is caused by a little green hopping bug which has appeared in masses on the cotton. The late-planted lot looks as if it will be no good at all, and in the early planted lot where bollworm was bad the pest seems to be preventing further setting of bolls. Our mealies look as if they may be some good.
>
> " (1924). If something is not done about this jassid soon we will not be able to grow cotton here. It is a pity, just as we have got the ginnery here. Tobacco looks as if it may be good one day, and we are trying to get a Co-op. going."

The weather is a subject constantly cropping up in John's diary. Without doubt it is *the* vital factor in the life of such as the owner of Doornhoek; unfortunately, it is the most invulnerable of all the factors affecting success in farming. Although in temperate countries progress in the study of crop-weather and forecasting problems is being made, the extreme vagaries of climate in South Africa coupled with the vast agricultural area, seem to indicate that John and his fellows can look forward to little but the most general advice in their struggles with the " arch enemy."

A rather inspiring attitude is taken by John.

> " . . . I hear the X's have gone mining again. Well, I suppose most things are uncertain in Africa. Most things are a gamble; therein lies the fascination for many men who have come here, though they would not admit it. Mining in this area is a gamble of the first order; I would rather gamble here on Doornhoek. There is soul in this. To do good ploughing, to do my crops well and keep them clean of weeds, to watch them grow, to feel depressed with them on drought, and to feel that

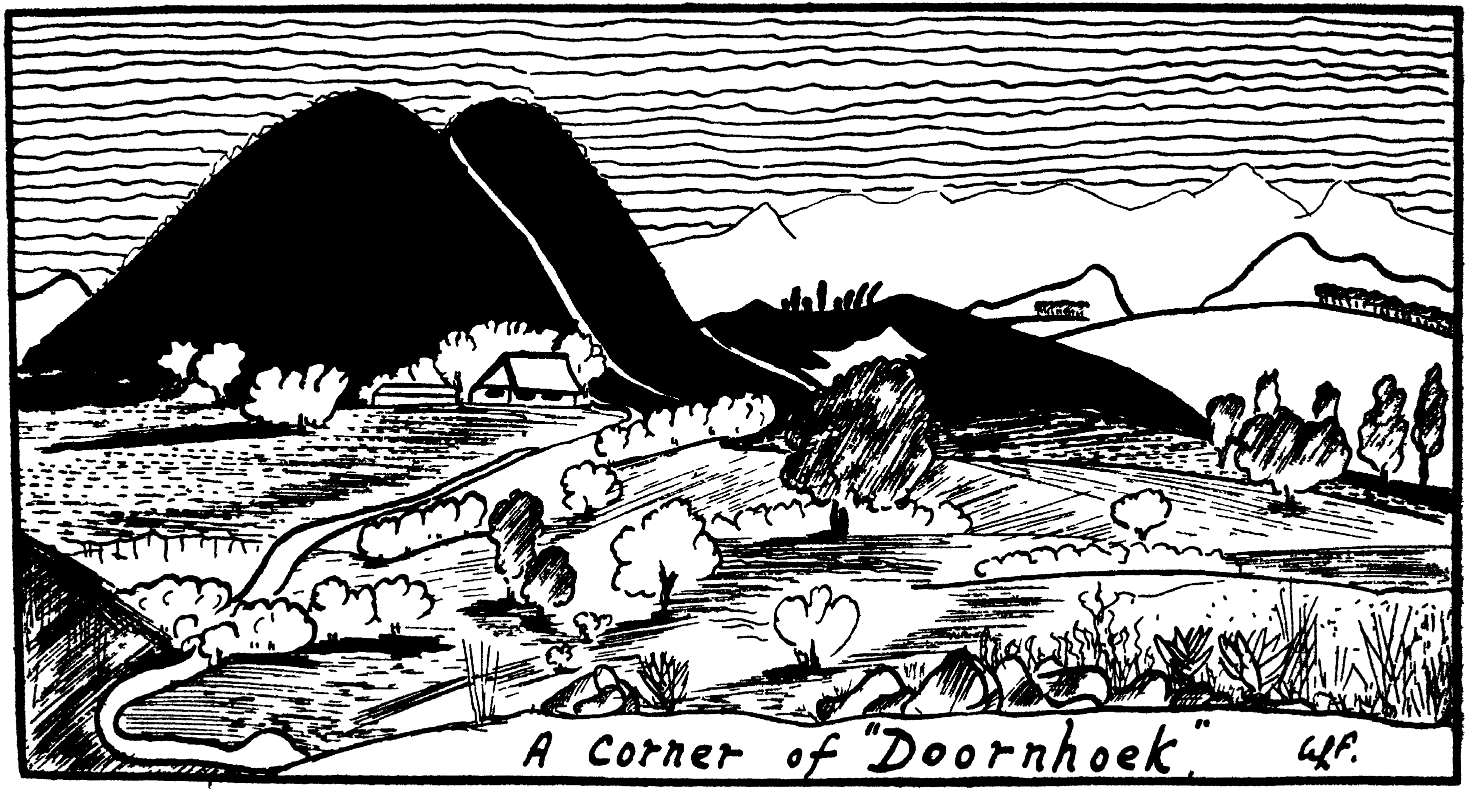
good feeling that life is not so bad after all when rains come like a gift from the gods. All this is life to me."

Sound, hard-working, hard-headed business man as he is, there is latent in John that essential characteristic of the good farmer—artistic temperament. Snatches from the diary convey a vivid impression of how the weather makes itself felt.

> ". . . This drought is getting on our nerves. Dust everywhere, plants wilting. Down on the '20 acre' I had a real good stand of U.4. It makes one sick to see it looking so dead. To-day at 4 p.m. great black clouds were rolling westward, but the storm passed along the Drakensberg. For 6 weeks now every storm has passed us."
>
> ". . . The storm worked up quickly last night. I was rather afraid of the towering white clouds in front of the black ones, and sure enough this morning I find 8 acres of my best tobacco in shreds. Hail again, and the best part of £800 gone. Still we are lucky, for last year our neighbour had all his tobacco and all his cotton blotted out, whilst we had not a spot."
>
> ". . . At last good rains have come. Only just in time to save our crops after a six weeks' drought, as so often is the case. It is astonishing how suddenly all seems right again. It is a great relief, but after some weeks of the nightly—'if we get rain soon,' I come to realize what a great game of 'if' is ours! Despite frequent periods of anxiety, it is extraordinary how often the rain does come just in time. Africa is an amazing country of ups and downs, but fortunately it is often, for many of us, a case of *downs and ups*. If one has a number of plantings of different crops, as is, of necessity, usually the case, the weather, with any luck, will be all right for some of them anyway."
>
> ". . . After the storm last night I see big washouts on A's land. I thought he would have trouble on that slanting land as he refuses to put in storm drains. I am glad my lands are mostly on the flat, and where the land does slant grass banks prevent wash."

A recent, somewhat lengthy entry in the diary, written evidently when John was feeling in a philosophic mood, sums up things agricultural as they appear to him.

> ". . . Have been thinking over things generally to-night as I sat over a sundowner on the stoep. There is no doubt in



A Corner of "Doornhoek".

my own mind that cotton and tobacco are the crops to grow in this district. Now that we have the U.4 and 4/4 we have something that has overcome our old enemy, jassid, and is good yielding. Cotton seems to withstand our droughts better than other things. It is a nice crop to work with. If only the price were good we should most of us be growing quite a lot of it, especially now that the ginnery and marketing system have been put in order. The adverse gold exchange on cotton sold to the United Kingdom is disheartening, as is the decision of the Government to allow us only a 10 per cent. bounty in the form of adjustment. This is not retrospective, so that we stand to lose heavily on most of the cotton sold during the first few months after the crop comes off. With our snuff tobacco we are at present assured a steady interior native market, and the Co-op. is now on its feet. We may, one day, have to export, and samples have been reported suitable for sale as heavy plug cut or chewing tobacco in the United Kingdom. We badly need some alternative crops, to give our lands a change and to keep them going in times when, say, cotton prices are down. The produce from these should preferably have a use as a food for our native labour and cattle, be saleable on interior markets, and have export possibilities. White grain maize and various beans are suited to the first purpose. In some years we have good crops of mealies, but I personally have come to look on them as liable to be a complete failure. Our trouble may lie in that we have always grown long period varieties of the dent type. Some shorter period white mealies of the flint type went through a very bad time with me this year, but seem to be able to withstand drought, and much to my surprise have set a fair crop which should go a long way towards feeding the boys and cutting down monetary outgoings for meal rations. Ground-nuts are another possibility on our lighter lands. These we can always sell to natives locally for 10s. a bag, and if put in early I have known them give over 12 bags per acre; they seem to avoid the 'rosette' disease when early planted, before Christmas. Of the beans, large speckled sugars fetch a good price for native feed. I am interested in the soy bean. It is said to be a good soil improvement crop, one can make hay of it, and the beans have an export market for oil crushing, I believe, but it seems to me likely to have a widening interior market if the Union cattle industry expands, as soy-bean meal and cake have a high feeding value. The residue after oil crushing would fit in well with

> cotton-seed cake, maize and other beans in a concentrate ration. When I look back on what I said above, I am struck by the fact that, apart from definite export crops like cotton, or citrus, etc., which latter I do not include in my own farming scheme, the white farmer in the Union seems to be occupying much of his time in providing food, maize, beans, etc., and luxuries, such as tobacco, for the vast black population. The native is not encouraged to fend for himself."

One would like to see many more " John McMarrs " in the South African cotton belt, and a good price for cotton prevailing. However, John is convinced that things will right themselves, and that one day his pet crop will again command a good figure. " Pessimist in speech, optimist in heart "—John is a true farmer.

Received May, 1932.

COMPARATIVE COTTON PRICES

BY

JOHN A. TODD, M.A., B.L.

There have been two main features in the movement of cotton prices during the past season. As the result of the enormous American crop of 1931 cotton prices in New York touched the lowest level in history; but owing to England going off the Gold Standard in September, 1931, prices in Liverpool did not apparently show the same decline. Thus on June 9, 1932, June futures in New York touched 4·85 cents as compared with the previous low record of 4·98 cents in the first week of November, 1898. In Liverpool the lowest actual quotation of the season was 3·38d. for October futures on the morning of August 10, 1931, when the market reopened after the fateful Bureau report which was issued on Saturday (8th) after the Liverpool market closed. On June 10, 1932, July futures in Liverpool touched 3·76d., but allowing for the rate of exchange (which touched $3·67 that day) this is equivalent to only 2·84d. This, however, falls considerably short of the record low price in Liverpool, which, as far as we can ascertain, was 2·56d. in January 1895.

The effect of the exchange factor is seen in all our tables. Thus in Table I. the season's average for the American price of Upland shows a heavy reduction, but all the other prices being on a sterling basis show comparatively little change. It must be remembered that Egyptian currency is also linked to sterling, so that prices in Egypt followed those in Liverpool instead of New York. As it happens, however, we are unable to give the season's average price for Alexandria because the publication from which we took this has apparently been discontinued.

The effect is also seen in Table II. (Spot Prices of American and Egyptian in Liverpool, Alexandria and New Orleans) in the sharp rise from August to September in all the prices except New Orleans. Sterling prices, however, failed to hold the rise and tailed off again till the end of December, when a new rise carried them up again to the end of February. With March, however, there began a long decline which in the case of Sakel carried prices very nearly down to the low level of August, for on June 4, spot Sakel in Liverpool was 5·55d., which, allowing for the rate of exchange ($3·69), is equivalent to only 4·21d. The previous low record for Egyptian prices is 4·19d. for F. G. F. Brown, which was touched both in 1894 and 1898. It is of course difficult to compare Sakel prices today with those of Brown in the old days, but even on this low level of prices there ought to be a difference of at least ½d. a pound in favour of Sakel. Further, in making comparisons of prices over such a long period account ought to be taken of the difference in the general level of prices; in 1894 and 1898 this was only about 93 per cent. on the base year (1900) against 113 per cent. in June, 1932.

From the low point of June prices of commodities in general showed an upward tendency, and cotton had its share in the rise, even before the shock of the first American Bureau report came to send prices up with a rush, thus exactly reversing the history of the first month of last season.

Table II. also brings out the very erratic movement throughout the past season of the relative prices of American and Egyptian cotton as shown by the spot premiums in Liverpool. During the winter the premiums sagged very considerably both for Sakel and Uppers, but the low prices of the latter enabled the Egyptian Government to dispose of considerable quantities of their stocks on terms very favourable to the purchasers, a special effort being made to induce countries which normally used American to replace it with Egyptian at these very low prices. In the latter part of the season, however, Egyptian relative prices made a good recovery, the Uppers premium especially being well above the average of recent years. With the sharp rise of American in August, however, Egyptian prices relatively lost much of what they had gained. In this connection Sakel is apparently beginning to feel the effect of the competition of Sudan Sakel, the crop there having made an unexpected recovery last year both in quantity and quality.

Table III. gives the prices of other varieties. The chief feature in the movement of prices of these Outside Growths has again been the relative movement of Tanguis and East African compared with Uppers. It will be remembered that during the period of Egyptian Government participation in the market Uppers went well above Tanguis and East African, but this was followed by a sharp reaction when Government intervention ceased; and during most of this season Uppers and East African have been very close together with Tanguis well above both. Towards the end of the season, however, Uppers has again appreciated relatively. In this table we formerly gave the quotation for Rough Peruvian as well as Tanguis and Smooth, but that quotation has apparently now dropped out of the Liverpool circulars altogether, and we have utilised the space to insert a quotation for South African instead. This affords some interesting comparisons in the relative prices of East, West and South African cottons.

The most curious feature of the season, however, has been the extraordinary position with regard to the relative prices of Indian and American cotton, which unfortunately is not fully shown by the figures in Table III. because that table gives only spot prices, and the abnormal situation applied chiefly to futures. This position was referred to in the July issue in dealing with the Indian statistics, and we need only add that it has now been rectified by the sharp appreciation of American cotton since August 8.

TABLE I.—HISTORY OF COTTON PRICES, 1899–1932.

SEASON'S AVERAGES.

Season.	*Liverpool Prices (Pence per Lb.).*					*Alexandria.*	*American Price of Upland.*	*Index Numbers of General Prices.*	
	Sea Island.	*Brazil.*	*American*	*Indian.*	*Egyptian.*				
	Cents per Lb.	Pernam Fair	Middling	No 1 Fine Oomra	F. G F. Brown.	Dols per Kantar	Cents per Lb	Year	
1899–00	16·70	5·06	4·87	4·40	6·81	*12·28	7·60	1900	100·0
1900–01	16·40	5 50	5·16	4·37	6·87	13·80	9·30	1901	96·7
1901–02	19·30	4·87	4·78	4·19	6·31	10·42	8·10	1902	96·4
1902–03	†25·00	5·57	5·44	4·47	8·44	13·65	8·20	1903	96·9
1903–04	28·40	5·16	6·94	5·56	8·56	16·65	12·16	1904	98·2
1904–05	27·12	5·25	4·93	4·62	7·37	13·97	8·66	1905	97·6
1905–06	26·38	6·23	5·94	5·00	9·25	15·99	10·94	1906	100·8
1906–07	36·70	6·97	6·38	4·87	10·37	19·16	10·01	1907	106·0
1907–08	35·59	6·79	6·19	5·03	8·81	18·21	11·46	1908	103·0
1908–09	23·39	5·84	5·50	4·94	8·44	15·46	9·24	1909	104·1
1909–10	32·85	8·34	7·86	6·31	13·12	23·30	14·29	1910	108·8
1910–11	35·62	8·27	7·84	7·03	10·75	20·66	14·69	1911	109·4
1911–12	23·73	6·70	6·09	5·63	9·56	17·25	9·69	1912	114·9
1912–13	25·00	7·11	6·76	6·16	9·79	18·28	12·20	1913	116·5
1913–14	23·47	7·47	7·27	5·88	9·45	19·02	13·49	1914	117·2
1914–15	22·00	5·71	5·22	4·46	7·34	12·01	7·94	1915	143·9
1915–16	27·00	8·22	7·51	6·09	10·42	19·28	11·99	1916	186·5
1916–17	50·00	13·03	12·33	10·32	21·56	37·81	18·41	1917	243·0
1917–18	80·00	24·13	21·68	18·78	‡30·97	38·52	28·86	1918	267·4
1918–19	65·00	23·96	19·73	18·13	27·85	37·20	30·36	1919	296·5
1919–20	*Peruvian*	30·00	25·31	19·23	60·34	87·81	38·21	1920	365·7
1920–21	*Tanguis*	13·24	11·89	9·20	30·24	34·50	16·08	1921	229·7
1921–22	Good	11·40	11·37	9·60	19·75	34·28	17·78	1922	185·0
1922–23	16·87	14·62	14·92	11·14	17·29	30·71	24·06	1923	185·3
1923–24	20·15	18·20	17·66	13·35	21·55	39·79	31·67	1924	193·6
1924–25	18·21	14·67	13·76	11·95	29·82	39·49	24·27	1925	185·4
1925–26	15·15	11·09	10·77	8·97	20·05	30·47	19·88	1926	172·5
1926–27	9·95	8 32	8·15	7·18	15·39	21·49	12·96	1927	164·7
1927–28	12·52	11·36	11·17	9·21	19·39	29·69	19·72	1928	163·4
1928–29	12·25	10·72	10 52	8·03	18·14	25·88	18·92	1929	158·9
1929–30	10·44	8·67	9·09	6·39	14·52	20·36	17·24	1930	139·2
1930–31	6·78	5·67	5·71	4·02	9·06	12·10	9·57	1931	121·3
1931–32	6·17	4·86	4·82	4·32	6·80		5·89	1932	118·6

*** These figures are F. G. F. Brown till 1914, since then composite figures embracing G. F. Sakel, G. F. Ashmuni, and G. F. Brown**

† South Carolina. **‡ F. G. F. Sakel.**

TABLE II.—SPOT PRICES OF AMERICAN AND EGYPTIAN COTTON IN LIVERPOOL, ALEXANDRIA, AND NEW ORLEANS ON THE LAST FRIDAY OF EACH MONTH.

Month.	*Liverpool.*					*New Orleans American Middling.*	*Alexandria.*	
	American Middling.	*Egyptian F. G. F. Sakel.*		*F. G. F. Uppers.*			*F. G F. Sakel.*	*F.G.F. Uppers.*
	Pence per Lb.	Pence per Lb	Premium per Cent	Pence per Lb	Premium per Cent	Cents per Lb.	Dollars per Kantar	Dollars per Kantar.
1929–30.								
August ..	**10·58**	**17·25**	*63*	**11·75**	*11*	**19·10**	**33·25**	**21·43**
September	**10·20**	**16·50**	*62*	**11·30**	*11*	**18·14**	**32·12**	**20·68**
October ..	**9·96**	**15·55**	*56*	**10·87**	*9*	**18·05**	**28·62**	**19·81**
November	**9·59**	**14·65**	*53*	**10·63**	*10*	**17·17**	**27·12**	**19·06**
December	**9·51**	**14·20**	*49*	**10·44**	*11*	**17·11**	**26·87**	**19·18**
January ..	**8·85**	**14·25**	*61*	**10·34**	*17*	**15·89**	**26·87**	**19·25**
February	**8·49**	**13·55**	*60*	**10·11**	*19*	**15·16**	**26·37**	**19·18**
March ..	**8·44**	**14·20**	*68*	**10·27**	*22*	**15·48**	**27·37**	**19·06**
April ..	**8·74**	**14·30**	*64*	**10·42**	*19*	**15·54**	**27·37**	**19·43**
May ..	**8·58**	**13·65**	*59*	**10·11**	*18*	**15·45**	**27·62**	**19·43**
June ..	**7·74**	**12·55**	*62*	**9·58**	*24*	**12·85**	**27·62**	**19·25**
July ..	**7·47**	**12·40**	*60*	**9·44**	*26*	**12·75**	**27·37**	**18·62**
1930–31.								
August ..	**6·64**	**10·45**	*57*	**8·50**	*28*	**10·80**	**25·87**	**14·00**
September	**5·89**	**10·05**	*71*	**8·22**	*40*	**10·06**	**19·87**	**13·00**
October ..	**6·24**	**9·65**	*55*	**6·74**	*8*	**10·89**	**18·25**	**12·31**
November	**5·91**	**9·35**	*58*	**6·58**	*11*	**10·22**	**16·12**	**11·43**
December	**5·31**	**7·85**	*48*	**6·09**	*15*	**9·40**	**13·75**	**10·62**
January ..	**5·63**	**8·85**	*57*	**6·52**	*16*	**10·16**	**16·25**	**11·50**
February	**6·18**	**10·35**	*67*	**7·72**	*25*	**10·81**	**19·07**	**13·95**
March ..	**5·85**	**9·45**	*62*	**7·00**	*20*	**10·59**	**16·97**	**12·50**
April ..	**5·62**	**8·30**	*48*	**6·42**	*14*	**9·89**	**14·87**	**11·25**
May ..	**4·80**	**7·80**	*63*	**5·78**	*20*	**8·45**	**14·47**	**10·05**
June ..	**5·43**	**8·20**	*51*	**6·47**	*19*	**10·21**	**14·62**	**11·10**
July ..	**4·62**	**6·95**	*50*	**5·53**	*20*	**8·37**	**12·52**	**8·95**
1931–32.								
August ..	**3·83**	**5·95**	*55*	**4·79**	*25*	**6·85**	**10·87**	**8·20**
September	**5·19**	**7·85**	*51*	**6·15**	*18*	**5·93**	**13·62**	**9·70**
October ..	**4·99**	**7·35**	*47*	**5·82**	*17*	**6·47**	**13·22**	**9·45**
November	**4·90**	**7·15**	*46*	**5·59**	*14*	**5·99**	**13·02**	**9·30**
December	**5·39**	**7·05**	*31*	**5·90**	*9*	**6·31**	**12·22**	**10·05**
January ..	**5·50**	**7·35**	*34*	**6·27**	*14*	**6·63**	**13·42**	**11·00**
February	**5·79**	**7·80**	*35*	**6·83**	*18*	**7·05**	**14·32**	**12·10**
March ..	**5·15**	**7·05**	*37*	**6·15**	*19*	**6·52**	**12·17**	**10·65**
April ..	**4·82**	**6·55**	*36*	**5·77**	*20*	**5·84**	**11·47**	**10·25**
May ..	**4·45**	**5·95**	*34*	**5·33**	*20*	**5·59**	**10·67**	**8·90**
June ..	**4·41**	**6·30**	*43*	**5·53**	*25*	**5·16**	**11·42**	**9·60**
July ..	**4·67**	**7·10**	*52*	**6·14**	*31*	**5·84**	**13·32**	**10·70**
1932–33.								
August ..	**6·45**	**8·75**	*36*	**7·70**	*19*	**8·52**	**16·57**	**13·95**

TABLE III.—MONTHLY SPOT PRICES OF VARIOUS KINDS OF COTTON IN LIVERPOOL, 1929–32.

ON THE LAST FRIDAY OF EACH MONTH. FROM THE LIVERPOOL COTTON ASSOCIATION'S WEEKLY CIRCULARS.

(*For American in Liverpool and New Orleans—and Egyptian in Liverpool and Alexandria—see Table II.*)

Seasons.	*Peruvian.*		*Brazilian.*		*West African (Middling).*	*East African (Good Fair).*	*South African (Middling).*	*Indian (No. 1 Fine Oomra).*	*Percentage of Indian on American.*
	Tanguis (Good Fair).	*Smooth (Good Fair)*	*Sao Paulo (Fair).*	*Pernam (Fair).*					
1929–30.									
August ..	11·68	11·28	9·93	10·38	10·53	11·10	10·58	7·95	*75*
September ..	11·25	10 95	9 50	9·95	10·20	10·75	10·20	7·65	*75*
October ..	11·06	10·76	9·31	9·76	10·01	10·56	9·96	7·45	*75*
November ..	10 54	10·34	9·14	9·24	9·59	10·14	9·59	7·20	*75*
December ..	10·46	10·16	9·06	9·16	9·51	10·06	9·51	7·10	*75*
January ..	9 60	9·50	8·50	8·50	8·85	9·40	8 85	6·35	*72*
February ..	9·29	9·19	8·09	8·09	8·54	9·09	8·49	5·80	*68*
March ..	9 24	9·14	8·04	8·04	8·49	9·14	8·44	5·65	*67*
April ..	9·34	9·09	7·99	7·99	8·59	9·24	8·74	5·65	*65*
May	9·18	8·93	7·93	7·93	8·53	9·18	8·58	5·65	*66*
June ..	8 29	8·04	7·04	7·04	7·64	8·29	7·74	4·85	*63*
July	7 97	7·82	6·72	6·72	7·42	8 17	7·47	4·35	*58*
1930–31.									
August ..	7 14	6 94	5 94	5·94	6 59	7·54	6·64	4·10	*62*
September ..	6·54	6·44	5·69	5·79	5·94	6·89	5·89	3·80	*65*
October ..	6·84	6·74	6·09	6·19	6·24	7·19	6·24	4·50	*72*
November ..	6·51	6·41	5·76	5·86	5·91	6·86	5 91	4·20	*71*
December ..	6·01	5·76	5·36	5·46	5·36	6·36	5·31	3·75	*71*
January ..	6·33	6·08	5·68	5·78	5·63	6·68	5·63	4·03	*72*
February ..	7·03	6·63	6·23	6·33	6·18	7·23	6·18	4·58	*74*
March ..	6·70	6·30	5·80	5·90	5·90	6·90	5·85	4·23	*73*
April ..	6·47	6·07	5·57	5·67	5·67	6·67	5·62	4·13	*73*
May	5·60	5·30	4·80	4·90	4·90	5·90	4 80	3·49	*73*
June ..	6·18	5·88	5·38	5·48	5·48	6·48	5·43	4·14	*76*
July	5·37	4·97	4·57	4·67	4·67	5·67	4 62	3 84	*83*
1931–32.									
August ..	4·58	4·18	3·78	3·88	3·88	4·88	3·83	3·12	*81*
September ..	5 99	5·59	5·09	5·19	5·14	6·09	5·19	4·14	*80*
October ..	6·14	5·64	4·94	5 04	5·04	5·94	4·99	4·36	*87*
November ..	6 10	5·50	4·80	4·90	4·90	5·80	4·90	4·36	*89*
December ..	6·59	5·99	5 29	5·39	5·44	6·19	5·39	5·03	*93*
January ..	6·60	6·10	5 50	5·55	5·55	6·30	5·50	5·43	*99*
February ..	6·94	6·44	5·84	5·89	5·89	6·64	5·79	5·45	*94*
March ..	6·27	—	5·17	5·22	5·22	5·97	5·15	4·75	*93*
April ..	5·97	—	4·87	4·92	4·87	5·62	4·82	4·40	*91*
May	5·50	—	4·50	4·55	4·45	5·25	4·45	4·01	*90*
June ..	5·31	—	4·41	4·46	4·41	5·11	4 41	3·99	*90*
July	5·67	—	4·77	4·82	4·77	5·47	4 67	4·33	*93*
1932–33.									
August ..	7·40	—	6·50	6·55	6·50	7·45	6.45	5.75	*89*

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

477. Report on the Work of the Indian Trade Commissioner during 1931-32. By H. A. F. Lindsay. The usual interesting and informative report. The various chapters deal with modern trade tendencies; Indian timbers and minerals; agricultural products—foodstuffs and industrial materials; trade publicity; committees and conferences; staff and acknowledgments. Various appendices are included.

The slight improvement which was noticed last year in the United Kingdom's imports of raw cotton from India was not maintained, and the quantity was just below that for 1929. Towards the end of the year under review very little business was done in Indian cotton because of its relatively high price as compared with American and Egyptian.

In examining India's exports of raw cotton in 1931, two very important factors must not be lost sight of. One is the ever-growing demand in the country itself on account of the steady growth of the cotton manufacturing industry in India, and the other the comparatively poor crop of 1931. Both these factors are responsible for India importing more and exporting less. Thus her imports of raw cotton jumped from about 23,500 tons in 1929 to over 81,000 tons in 1931, whilst her exports fell from just over 700,000 tons in 1929 to 570,000 tons in 1931.

478. Indian Central Cotton Committee. At the twenty-fifth meeting, held in Bombay on August 1-2, many important matters came before the Committee, including the following: the introduction of legislation prohibiting the growing of Pulichai cotton in certain areas of the Madras Presidency; the compilation and publication of the All-India Cotton Forecasts; the working of the Cotton Ginning and Pressing Factories Act; the cost of growing cotton in India. The general progress report of the various research schemes financed by the Indian Central Cotton Committee was reviewed, and great satisfaction was expressed with the work so far done. The memorandum on Publicity and Propaganda was discussed at great length.

479. Spinning Test Reports on Indian Cottons. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 69-76, 1931-32.) The circulars contain the grader's reports and spinning test results for Broach, Bailhongal, Hubli-Kumpta, Kadi, Hubli Upland, C.P. No. 1, Muttia, Berar, Lattur, Nanded, Surat, Punjab-American, Jagadia Farm, Navsari, Dhollera, Westerns, Farm Westerns and Kumpta cottons for the 1931-32 seasons.

480. Spinning Tests on Mixings of Long Staple and Short Staple Indian Cottons. By N. Ahmad. (*Tech. Bull. Ser. A., No.* 20, 1932, *Ind. Cent. Cott. Comm.*) The results of the tests indicate clearly the harmful effects of adulterating better types of cotton with inferior types. Such a practice invariably impairs the quality of yarn, even when the proportion of the short staple cotton is relatively small. The number of yarn breakages in the ring frame mounts up, yarns become progressively less even, and in one case (4F and Mollisoni) are found to be considerably neppier than those spun from either of the two pure cottons. The diminution in yarn strength, in some cases, is phenomenal. Karunganni, which in the pure unadulterated state will yield a good 20's warp, is found suitable

for no more than 12's standard warp counts when mixed with 25-30 per cent. of the short-staple Pulichai cotton. It is further found that if the fibre-properties of the short-staple variety differ considerably from those of the long-staple variety, the diminution in yarn strength is both regular and continuous, so that, within a wide range of percentage composition, the spinning performance is very nearly proportional to the amount of the inferior growth present in the mixing. Such, for instance, is the case with P.A. 289F and Mollisoni. The former has a long and fine staple, while the latter is a relatively coarse and short-stapled variety. It follows that, as the percentage of Mollisoni in the mixtures is gradually increased by equal amounts at a time, the highest standard warp counts for which the mixtures are found suitable decrease in a regular manner—a decrease of three units in the latter being associated with an increase of 10 per cent. in the proportion of the former. On the other hand, when the fibre-properties of the inferior variety do not differ so radically from those of the superior variety, the spinning performance of the mixtures declines at first rapidly and afterwards slowly, as the proportion of the short-staple cotton is gradually increased. The difference in the behaviour of these two series of mixtures has been explained quantitatively in terms of the modification of their fibre-properties.

481. PERIODIC FAILURES OF THE PUNJAB-AMERICAN COTTON CROP. By R. Thomas. (*Agr. and Livestock in India*, ii., 3, 1932, p. 243.) In some years the Punjab-American cotton crop has been afflicted with what appears to be a mysterious "disease." The damage resulting in a year of general crop failure may exceed £5,000,000. The disease was fairly general over the Punjab Province in 1919, 1921, and 1926-28. The symptoms of the disease are described and its distribution in time and place is discussed. Some earlier theories advanced to account for these crop failures are critically examined. Factors which are believed to influence the intensity of crop failures in any year are discussed. The author is of opinion that the basic cause of these periodic crop failures in the Punjab is the cotton White Fly (*Bemisia gossypiperda*). The distribution and life history of the pest are described. The nature of the damage done by it in cage experiments is compared with the symptoms of the "disease" in a failure year. The intensity of White Fly in any year is believed to be controlled largely by rainfall during the months May to August, and also largely by predators and parasites. Practical and economic methods of controlling the pest are described; these include:—spraying the cotton crop during July and August with rosin-soda compound; manuring at the flowering stage (end of August or early September) with a light dose of nitrogenous manure; delaying the sowing until late in May or early in June; breeding strains of cotton relatively immune to the effects of White Fly attack.

482. INDIAN COTTON AND CLOTH PRICES: ANALYSIS. By M. D. Altekar. (*Indian Text. J.*, 42, 1932, p. 154 and 156. Abstr. from *Summ. of Curr. Lit.*, xii., 12, 1932, p. 362.) The prices of raw cotton and cotton goods are examined in relation to fluctuations in all commodities combined. Figures prepared by the Department of Statistics and Commercial Intelligence, Calcutta, are given for 1914-1931. The fall in cotton manufactures has been much slower than the general fall in prices in recent years. Taking the index number for 1914 to be 100 in each case, the 1931 index number for the price of cotton manufactures is 123, while that of raw cotton is 83 and that of all commodities 96. Thus cotton piece goods are still sold, roughly speaking, at a price 25 per cent. higher than that in 1914, whilst the general level of prices has gone slightly below the 1914 level. The recent financial crisis and the extension of tariffs will cause a rise in prices.

483. INDIAN COTTON AND CLOTH PRICES: ANALYSIS. (*Indian Text. J.*, 42, 1932, p. 219. Abstr. from *Summ. of Curr. Lit.*, xii., 12, 1932, p. 362.) The

conclusions drawn by Altekar are criticised, and it is pointed out that the index numbers selected by him are not quite relevant for the purpose. A table showing the annual averages of index numbers for raw cotton and for two varieties of locally-made piece goods at Bombay is given. These figures show that the prices of raw cotton fell between 1918 and 1921, increased between 1922 and 1924, and generally declined thereafter with a few exceptions. The prices of the locally-made varieties of cloth reached their peak in 1920 and then began to fall. But the fall in the prices of piece goods has not been proportionate to the corresponding fall in the prices of raw cotton. Since 1926, the cloth prices appear to have fallen relatively more than is warranted by the fall in the price of raw cotton.

[*Cf.* previous abstract.]

484. COTTON GOODS: IMPORTS INTO INDIA (1929-31). (*Indian Text. J.*, 42, 1932, p. 189. Abstr. from *Summ. of Curr. Lit.*, xii., **11**, 1932, p. 331.) An analysis of Indian import trade in yarns and piece goods has been prepared by a Committee of the Bombay Millowners' Association. Details are given. Particular attention is paid to the great influence of China in the grey yarn trade, and to the kinds of cloths for which Japan is in the ascendancy.

485. INDIAN COTTON CHART, 1931-32. We have received from Messrs. Chunilal, Mehta and Company, Bombay, a copy of the cotton chart which is published by them annually at the termination of the Broach contract for April-May delivery. This year's chart gives as usual April-May Broach quotations in Bombay and corresponding quotations for American cotton in Liverpool and New York. Silver quotations are not given in this issue owing to the necessity for the inclusion of sterling-dollar cross-rate, which has of late become an important factor affecting cotton quotations.

486. STUDIES IN TROPICAL LAND TENURE. By H. M. Leake. (*Trop. Agriculture*, ix., **8**, 1932, p. 245.) This paper deals with the land tenure systems of India.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

487. The following reports have recently been received:

Br. Cott. Grow. Assen., Ann. Rpt., 1931.
East Malling Res. Sta., Ann. Rpt., 1931.
Empire Marketing Board, Ann. Rpt., 1931-32.
CYPRUS: Ann. Rpt. of Dpt. of Agr., 1931.
FIJI: Ann. Rpt. of Dpt. of Agr., 1931.
NORTHERN RHODESIA: Ann. Rpt. of Dpt. of Agr., 1931.
SOUTHERN RHODESIA: Rpt. of Sec. of Dpt. of Agr., 1931.
SUDAN: Ann. Rpt. of Dpt. of Agr. and Forests, 1931.
,, Rpt. of Govt. Chemist, 1931.
TANGANYIKA: Ann. Rpt. of Dpt. of Agr., 1930.

488. BRITISH COTTON GROWING ASSOCIATION. The Twenty-seventh Annual Report is of the usual interesting nature. It is stated that the cotton trade has again suffered a period of acute depression, although some improvement resulted from the suspension of the gold standard by the British Government, which caused a substantial advance in cotton values in this country as compared with the very low prices which had been ruling for some time previously.

The total number of bales dealt with by the Association during the year was 121,362, of a value of £1,338,657. The work of the Association in the Colonies is described, and some useful statistical appendices are included.

489. Empire Marketing Board. Annual Report for 1931-32. (H.M. Stat. Off., price 1s. net.) An account of the work of the year given under the following heads: The Empire Marketing Board in 1931-32; Grants for Research and Development; Marketing; Economic; Investigation and Intelligence; Publicity.

In connection with cotton disease research, for which a grant was made to the Rothamsted Experimental Station, the experiments on the influence of environmental conditions on the blackarm, or angular leafspot, disease of cotton plants have been continued. The work has dealt mainly with the influence of air temperature, atmospheric humidity, and alternating environmental conditions on the disease. A paper giving the results of the experiments on constant air temperatures has been published, and also a paper describing the construction of a new type of humidity control.

490. Cotton Crops. By J. A. Todd. (*Times Trade and Eng. Supplt.* May 21, 1932.) The author's annual survey of the progress of cotton growing in the Empire. Tables are included showing the Empire cotton crops from 1925 to 1931, and the United Kingdom's consumption of different cottons, both Empire and Foreign, from 1927 to 1931.

491. ASIA: Cyprus. *Cotton Cultivation in* 1931. (Abstr. from *Ann. Rpt. Emp. Cott. Growing Corpn.*, 1932.) The area planted to cotton in 1931 was less than the preceding year, and the yield was less. Considerable damage was again caused by bollworms, and propaganda was carried on to induce farmers to plant their cotton earlier than is the usual practice, in order to obviate much of the loss and damage caused by these pests. No fresh supplies of cotton seed were imported in 1931, but the Department of Agriculture distributed to farmers over 6 tons of seed of the " Mesowhite " variety, which were produced locally from the seed imported from Iraq in 1930. This variety, which gave very satisfactory results in 1930, was, however, not so favourably reported upon as regards yield in 1931, either under irrigation or as a non-irrigated crop. The following experimental work was carried out during the season under review. At Nicosia: time of sowing trials with different varieties; trials under irrigation with Mesowhite variety. At Livadhia: fertiliser trials. At Karavostassi and Vatilli: special trials with Mesowhite variety. The time of sowing trials again demonstrated the advantages of early sowing.

492. *Problems of Cotton Production.* (*Agr. Supplt. No.* 49 to the *Cyprus Gazette* No. 2231, July 29, 1932.) Outlines the history of cotton in the island. Cyprus at present is an unimportant source of Empire supply as the methods of cultivation, and especially subsequent handling of the crop, are not quite up to the standard of those now generally followed in the leading cotton-producing countries. The available area suitable for cotton cultivation is estimated at 50,000 acres, of which 33,000 acres are suitable for growing " dry " or non-irrigated cotton, and the remaining 17,000 acres for irrigated cotton. The limiting factors in obtaining increased production are an insufficient supply of irrigation water and a liability to droughts. Climatic conditions are on the whole favourable, and there is little risk of rain when the crop is ripening. Soils are suitable and contain the necessary constituents for cotton.

Brief notes are given of the cultivation methods that should be followed in Cyprus by small farmers, who are at the present time the sole producers of cotton in the island. It is stated that when the Cypriot farmer can be induced to follow better methods of cultivation, picking, and sorting his cotton, the merchants will be in a better position to supply a more exacting and incidentally a more stable and remunerative market than the market in neighbouring countries with which they trade at present.

493. IRAQ. *Problems of the Iraq Cultivator.* By D. D. Paterson. (*Trop. Agriculture*, ix., 8, 1932, p. 252.) *Cotton Cultivation.*—While a short-staple Asiatic cotton has been grown in Iraq for many years, it is only during the post-war period that an attempt has been made to grow a cotton more suited for the export market. Since 1918 experiments have demonstrated that the Webber strain of long-stapled American Upland is the most suitable for Iraq conditions. The seed is sown on ridges by hand, and thinned to two plants on each hill when the plants are about 9 inches tall. Inter-cultivation is essential to insure good yields, and sixteen or seventeen irrigations are required by the crop. Under careful cultural treatment yields of over 1,000 lb. seed cotton per acre may be obtained. Unfortunately the ordinary *fellah* is rather more interested in his summer food crops, and cotton suffers as a result; thinning is omitted, cultivation neglected, overwatering indulged in when water is plentiful, and underwatering when it is scarce. In consequence, yields are sometimes as low as 150 lb. per acre, and the average for the country cannot be much in excess of 300 to 400 lb. In spite of this, steady progress has been achieved, as proved by the increase in the output from 60 bales of lint of 400 lb. in 1920 to 5,200 bales in 1928. While this latter is insignificant when compared with the world's total annual requirements, it illustrates the great potentialities of Iraq as a cotton-producing country.

494. AFRICA: NIGERIA. *Cotton Investigations.* (*Bull. Imp. Inst.*, xxx., 2, 1932, p. 217.) The Botanist, Southern Nigeria, in his report for the six months ended December 31, 1931, points out that " the present cotton-breeding problem is the attempt to combine the valuable agricultural characters of the ' Improved Ishan Strain A '—of which the most serious defect is that the lint is classed as ' rough ' by spinners—with the smooth lint of other cottons. Through the courtesy of the Empire Cotton Growing Corporation invaluable assistance is being supplied in two directions. Firstly, Dr. Harland in Trinidad is crossing Nigerian Ishan A with Sea Island cotton, and is also advising on the reduplication of this crossing which is being done locally. The first crosses have been made this season (1931-32), and some years must elapse before new strains are ready for extended trial. Secondly, certain other Ishan strains, raised from the hybrids mentioned in previous reports, and at present in the single plant stage, were examined in England for the roughness character by the Spinning Tests Committee of the Corporation, and were later tested at the Shirley Institute, Didsbury. The examination and tests have proved that certain strains are free from roughness, and should be acceptable to the spinners as smooth cottons. The 1931-32 and the following season should show how far these new strains breed true for the smoothness character, and how far they are satisfactory when judged agriculturally. The cotton this season, and especially that of the selection plot, has suffered severely from insect pests and from diseases. *Helopeltis* (*H. bergrothi*) attack, as of late years, was very prevalent. Jassid (*E. facialis*) infestation of the new strains, and also of the normally resistant Ishan strain A, has been severe. Cotton stainers were unusually numerous for indigenous cotton, and boll puncturing was very heavy. Much stained and damaged lint was harvested, and the Mycologist identified damage due to Internal Boll disease (*Nematospora gossypii*)."

The Chief Mycologist reports that cotton seed disinfection experiments to control bacterial diseases were carried out for the third time at Ilorin. The two previous experiments gave no significant results as regards increased yield, but that was explained by the unsatisfactory conditions of the experiment. In both cases screens of guinea corn designed to prevent spread of infection due to *B. malvacearum* were non-effective, and in addition the land available for the experiments was very poor. This year better conditions prevailed. The plot available was of better quality, and the screen between the plots of cotton was effective throughout the experiment. The seed was treated by soaking in 1 per cent. Germisan for ten minutes, and then drying back to the original weight in an air current at a temperature of 50° C. The screens consisted of early maize followed by guinea corn, and the land available for these screens was ridged along its length in one half and across its short side in the other half. In this way a very compact screen resulted. Disease estimations showed complete control of all seed-borne infection, and later very little disease affected the plants in the treated halves. The final assessment of disease gave a mean percentage of 7·4 for the treated plots, whilst in the untreated plots there were as many as 76·3 per cent. plants showing the disease. At the time of writing the crop figures showed an increase of over 100 lb. of seed-cotton per acre on all the treated plots as compared with the yield on the untreated plots.

495. *Cotton Growing near Lake Nyasa.* By Susette Cramer. (*Trop. Life*, May and June, 1932, pp. 88 and 107.) A popular account of a day on a cotton plantation.

496. NORTHERN RHODESIA. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1931, recently received.) At the Mazabuka station, two methods employed in 1929-30 for control of stainers were productive of a statistically significant decrease in stainer population, but unfortunately the resulting increase in the percentage of clean cotton did not cover the cost of the control operations. Similar results were obtained in the season under review, but it was found that the degree of staining varied in a remarkable way with the habit of the plant, and that habit was highly correlated with certain clearly defined, but as yet imperfectly understood, soil differences. During the year a technique for the rearing of stainers in the laboratory was evolved, and some measure of success was attained in the breeding of certain parasites; an unidentified Tachinid fly and a white mite which infests the adult stainer were the most important of these. The mite proved particularly fatal under conditions of intense humidity.

At the Fort Jameson station U.4 cotton has twice asserted its supremacy over other varieties, and gave yields of approximately 700 lb. of seed cotton to the acre during the year under review. If yields of this order could be maintained, and better prices obtained for cotton, the prospects of this crop as an alternative crop to tobacco would be definitely promising. Bollworm damage has been negligible during the last two seasons.

497. SOUTHERN RHODESIA. *Cotton Cultivation*, 1930-31. (*Ann. Rpt. of Dpt. of Agr.*, 1931.) From the report of the Chief, Division of Plant Industry, we quote the following: " The cotton industry, in which the Colony is fortunate in having the generous assistance of the Empire Cotton Growing Corporation, makes progress which, in view of the difficult climatic conditions in the earlier part of 1931 and the low price obtainable in the world's market for the product, is remarkable. The planted acreage was 9,028, and the average yield per acre of seed cotton was 300 lb., the highest yield since the exceptional 1923-24 season. The admirable work carried out at the Cotton Research Station near Gatooma has been continued, and it has now been possible to provide adequate accommodation in lieu of the deplorable and unsafe structure in which the work has been carried out hitherto. . . . There is fair reason for expectation that, with the constant improvement of seed made available by the work at the Gatooma station, and with the progressive improvement in the knowledge of the effect of local conditions, cotton will in the not remote future become a staple crop in suitable areas and will afford to the farmers in those areas a safe and productive alternative to maize."

498. SUDAN. *Cotton Cultivation*, 1930-31. (*Ann Rpt. of Dpt. of Agr. and Forests*, 1931) In the Gezira, the main source of Sudan Sakel cotton, climatic conditions were unsuitable A poor stand resulted from severe attacks of Blackarm, which occurred during an unfavourable seed time The resulting plants achieved a poor growth and were heavily infected by leaf curl disease. Crop prospects became gradually worse, the final yield of 1 34 kantars being the lowest yet experienced At Tokar and Kassala the yields were good in spite of the prevalence of leaf curl in both districts The proportion and quality of the higher grade cotton from these sources were also satisfactory The American cotton crops from both areas under irrigation and rain cultivation were about normal. In the south the seed issue was restricted to approximately the quantities issued the previous season, in order to place a limit on commitments for purchase of the crop. Such seed was readily taken up in spite of low prices.

Cotton Cultivation, 1931 32 After the very low yields in the Gezira in the previous season, it is most gratifying to be able to report that the present season in that area has been in every way satisfactory It is not possible to estimate to what degree the considerable improvement is due to each of the various causes to which it might be in part attributed The weather at planting was favourable. New seed was imported from Egypt for the whole area, and was treated by a disinfectant before sowing Sowing was carried out with great care, and a very thorough search was made for ratoon cotton springing from the roots of the previous season's crop, and for volunteer seedlings These were as far as possible exterminated The crop as a whole made an excellent start, and its growth and healthy appearance was up to the standard of the best crops grown since the initiation of the scheme Blackarm appeared later in many places, and became generally distributed throughout the scheme with the exception of the most northerly blocks Its behaviour was irregular, in some places it spread considerably, and in others remained localized and did little damage Taking the area as a whole, considerable loss has resulted from this cause, but very much less than in recent years Leaf curl also appeared, but to a relatively small extent, and caused little damage The most encouraging feature is the direct evidence that the Gezira soil can, under suitable conditions, grow as good a cotton plant as it ever did, both on the new and on the old established areas.

At Tokar the flood was a good one, and more than the average crop is anticipated In the Gash Delta the area was reduced, partly through the adoption of a rotation in watering, and partly through the depredations of locusts.

The crop of American Upland type cotton from irrigated land will show a falling off due to low prices, in spite of an excellent yield obtained at Zeidab and on the Government pumping scheme in Dongola Province

The rain cotton crop in the south will be reduced, chiefly due to the lateness of arrival and short period of the rainy season

499. *Cotton Investigations* (*Ann Rpt of Govt Chem*, 1931, Wellcome Trop. Res. Labs Khartoum) In connection with the leaf curl disease of cotton, some analyses of cotton plants and examination of soil samples have been made at Khartoum, but the results so far obtained shed no light on the cause of susceptibility in the plant

Results are given of the following investigations carried out at the Gezira Laboratory. Movement of soil salts under irrigation; moisture content of cotton plots; soil improvers; residual effect of gypsum; sulphate content of soils; effect of irrigation on Gezira soils, soil nitrogen, evaporation of irrigation water.

In the experiment on the effect of various soil improvers with and without ammonium sulphate, the improvers used were gypsum, calcium chloride, ferrous sulphate, and sulphur, which were applied in chemically equivalent amounts, and there were eight replicates with control plots. The following table gives the yield of lint in lb. per acre from the various treatments:

	No Ammonium Sulphate.	*With Ammonium Sulphate (400 lb. per Acre.)*
Control	181	279
Gypsum (2 tons per acre)	252	326
Ferrous sulphate	270	329
Calcium chloride	261	328
Sulphur	247	298

500. *Ginning Factories.* (*Ann. Rpt. of Dpt. of Agr. and Forests,* 1931.) The new ginning factory at Port Sudan operated successfully, and dealt with the whole of the Gash crop, that of northern Sakel-growing estates, and a portion of the Tokar crop. Its equipment consists of eighty roller gins and two presses, and electric power is provided by the main power station. An air-blast feed was adopted and has proved a success, and the new ball-bearing gins show a marked economy in power requirements over those of the older pattern. The seven ginneries operated by the Department of Agriculture carried out their functions successfully.

501. *Research Work,* 1930-31. (*Ann. Rpt. of Dpt. of Agr. and Forests,* 1931.) Work of all sections was mainly devoted to avoiding, controlling, or mitigating the effects of the two chief diseases affecting cotton in the Sudan—viz., Blackarm and Leaf Curl. Crop rotation, cultural and manurial experiments were also continued, together with the testing, comparison, and selection of different varieties of cotton.

From the close of the 1930-31 season the research work in agriculture and the allied sciences was reorganized with a view to obtaining the fullest possible co-operation between the different scientific sections engaged on this work, and which previously were distributed between the Wellcome Tropical Research Laboratories and the Department of Agriculture. The members of the staffs of these departments who were so employed were seconded to the newly formed Gezira Agricultural Research Organization, with headquarters at the Gezira Research Farm, Wad Medani. It was considered that the change would lead to increased efficiency in the work as a whole, and particularly in elucidating the problems confronting agriculture in the Gezira.

502. *Sudan Soils.* By — Burischowsky. (*Cong. Trop. Agr. Paris,* 1931, T.25. Abstr. from *Tech. Commn. No.* 21, Imp. Bur. of Soil Sci. Rothamsted, 1931.) Analyses of two Sudan soils, mechanical and chemical, also analysis of irrigation and drainage waters of Kayo. The low fertility of Sudan soils is in part due to the deficiency of the constituent rocks in plant nutrients, and also to the depletion of the soil by continuous cultivation without the use of manures. Run-off also contributes to the depletion of these soils. Methods suggested for their improvement are: reafforestation, the use of FYM, and green manuring, the cost of artificial fertilizers being prohibitive.

503. SWAZILAND. *Cotton Cultivation.* By S. Milligan. (*Finan. and Econ. Situation of Swaziland,* Rpt. of Comm. appointed by the Sec. of State for Dominion Affairs, January, 1932.) Cotton growing in Swaziland may be said to date from the post-war period when prices were high. With an influx of settlers the area rapidly increased and was still further augmented by the establishment of a large cotton-growing company in the south of the Territory. Prices unfortunately began to decline, and an increase in insect pests, more especially jassid, diminished the outturn per acre until the crop was barely paying at 9d. and 10d. per lb. of lint.

The discovery of a resistant variety to jassid, however, increased the expectation of yield to such an extent that cotton at 6d. per lb. can still be considered a remunerative price, not leaving perhaps very much for a moderate yield, but under average conditions paying its way with a surplus to spare. The whole area, of course, is not suited to cotton growing, the high lands, for example, being too bare and exposed and too subject to hailstorms to be safe. Within the middle-veld boundaries, however, cotton does well, is fairly free from pests, and exhibits qualities of drought resistance which are not found in the other established crops. In the case of maize, beans, and groundnuts, the absence of rain at the critical moment may reduce the yield by one-half. On the other hand, cotton may be said to have few critical periods, as the flowering does not take place all at once, but goes on continuously from the third month of growth onwards. Unless planted too late it may, therefore, recover from, and produce a good crop after a spell of drought or an attack by insects. It is, therefore, specially well suited for a climate of uncertain rainfall, especially uncertain distribution.

Low-veld Cultivation.—The above remarks apply to middle-veld and lower-middle-veld conditions—that is to say, down to the bottom of the foot hills. In the real low veld—that is, on the Lobombo flats—great difficulty has been experienced in establishing the crop, owing to the want of rain at planting time, but where crops have been planted in time and are not subject to undue drought thereafter, very good yields have been obtained—in fact, some of the best yields in the Territory have come from this area. The low veld may yet be a cotton area, but some alteration in the existing system of cultivation will first of all have to be worked out before further capital is expended. Although cotton has been, and can be, grown in the low veld with success, the price of the product will require to be higher than for the more stable conditions of the middle veld. Few cases of total failure of crops, such as often happens in the case of maize, beans, etc., have been recorded against cotton, and it is probably on that account the safest of all dry land crops in the middle and low veld.

504. TANGANYIKA. *Cotton Cultivation*, 1930. (*Ann. Rpt. of Dpt. of Agr.*, 1930, recently received.) During the year under review the cotton crop did not make headway owing to the special conditions of control, check, storage, and so forth, surrounding it, which were irksome to grower and buyer alike. Furthermore, in spite of active propaganda, cotton was invariably planted too late to give maximum returns. The deterioration in the average quality of the lint exported was due to the relatively increased amount of plantation-grown cotton, which was crop picked and not sorted. The amount of estate (non-native) production was 7,902 bales of 400 lb. The greater part of the estate-grown cotton was produced in the sisal-growing areas of Kilosa, Morogoro, and Dar-es-Salaam as an interplanted crop with young sisal.

A Cotton Board was appointed to advise Government in regard to the business end of the industry, and a cotton cess was imposed amounting to half a cent per lb. of native seed cotton sold. The total revenue from this source for 1930-31 was £3,893, and this sum was utilized for the purchase of seed, for the bagging and transporting of the same, and for the expenses in connection with the supervision of cotton markets and cotton buying generally. It is stated that the cotton cess is not an ideal method of securing the native his seed supply, and the whole subject needs very careful examination.

505. *Cotton Prospects*, 1932-33. The latest report from the Department of Agriculture states that cotton prospects in most districts are satisfactory.

506. UGANDA. *Cotton Prospects,* **1932-33** *Season. Eastern Province.*—The report for June received from the Dept. of Agriculture states that weather conditions were, in general, favourable for planting during May, and a considerable increase of early planted cotton is reported from most districts. The total acreage is expected to equal at least that of last year. During the past few years the Department has, following on the results obtained from sowing date trials, consistently advocated early planting, and this advice appears to have been appreciated by many of the growers. In Teso district it is estimated that over 21,500 acres were planted in May, as against 7,020 and 7,748 acres in the corresponding month of 1931 and 1930 respectively.

Northern Province.—Weather conditions were favourable in Lango district, and good germination is reported. One thousand two hundred acres were planted during May. Arrangements have been made to plant the whole of the West Nile-Madi area with S.G. 29 variety, and the requisite amount of seed was obtained from Bugondo, Teso district. As a result of the lowered viability of the seed from the crop in Gulu and Chua districts, 250 tons of fresh seed from Busoga were shipped to and distributed in these districts.

Buganda Province.—Good areas of land have been cleared in most districts, and in Masaka district some 28,000 plots were planted in May.

507. AUSTRALASIA: FIJI. *Cotton Cultivation,* 1930-31. (*Ann. Rpt. of Dpt. of Agr.,* 1931.) The production of the New Guinea hybrid cotton was discontinued in 1930, a Sea Island selected strain, S17, being the one grown in all cotton areas in 1930-31. Growers were advised to plant early, and seed was applied for in considerable quantity. The prospects of a heavy crop were, however, completely spoiled by gales in November, 1930, which destroyed 75 per cent. or more of early plantings, and again by the hurricane and floods of February-March, 1931. A week prior to this disastrous visitation the area planted was estimated at 2,500 acres, expected to yield 700-800 bales, while immediately afterwards the estimated output was only one-fifth of this. New seed was issued free, and many cultivators planted again with success, which was more marked owing to exceptionally dry conditions from April to December. The total purchases of seed cotton amounted to 404,834 lb. from 845 growers, of whom 73 were Fijians and 772 Indians.

508. *Cotton Prospects for* 1931-32 *Season.* (*Ann. Rpt. Emp. Cott. Grow. Corpn.,* 1932.) Sea Island seed will be given to all districts, but the acreage planted will be little more than one-third of last season. The disheartening experience of floods in two successive years, together with the low prices obtaining, have led a number of growers to give up cotton. Mr. Anson believes they will probably return to it again, and that the area will ultimately be larger than before, owing to the fact that the crop is being taken up more extensively by Fijians, whereas formerly it was grown almost entirely by Indians. The new Sea Island × New Guinea Kidney backcross is certainly promising, especially in yield. During the season 1929-30 a yield at the rate of 3,732 lb. per acre was obtained from a small plot of fifty plants. The average number of bolls which reached maturity on three of the best plants amounted to 641 per plant during the season 1929-30, and 814 per plant during the following season.

The Director of Agriculture has accepted a scheme put up by Mr. Anson for training Fijians in commercial agriculture. Two training centres have been selected and twenty cultivators are in training at each centre. Each centre grows cotton, a food crop, and a green manure crop, and at the end of the harvest the proceeds of the sale of the money crop are distributed among the workers. It is reported that at present the natives are most enthusiastic, and if this enthusiasm lasts, it is hoped to extend the scheme considerably.

509. WEST INDIES: Barbados. *Cotton Conference.* (*W. Ind. Comm. Circ.*, xlvii., **879**, p. 229.) The Cotton Conference held in Barbados reached a successful conclusion on April 7. The following decisions were made: that the cultivation of Sea Island cotton in the British West Indies should be continued as the main cotton crop; that no attempt should be made to establish a minimum price for Sea Island cotton under the conditions at present existing; that restriction of output was necessary; that steps should be taken to urge all British West Indian Islands and British Guiana to introduce and encourage the use of goods manufactured from West Indian Sea Island cotton; that, in each island, some system of grading should be adopted, standard grades be established, certified graders be employed, and a standard bale be adopted; that a West Indian cotton Growers' Association should be formed.

510. *Memorandum on the Cotton Situation.* (*Agr. Jour.*, Dpt. of Sci. and Agr. Barbados, vol. i., No. 1, 1932, p. 63.) An account of the damage caused to cotton cultivation by pink bollworm, which first appeared in the island in July, 1923. The pest has been greatly reduced by various measures of control—*e.g.*, disinfection of all imported cotton seed, alteration of planting date, improved cultivation, destruction of old cotton plants, and the enforcement of a " close season " of four months. It is considered that the period of four months is not sufficient, and an additional " close season " of one year in four is suggested in order to effect complete economic control of the pest.

511. St. Kitts. *Cotton Cultivation, 1932-33 Season.* (*W. India Comm. Circ.*, xlvii., **883**, 1932, p. 318.) Only a small acreage has been planted to cotton, but this looks very promising, and the returns should be fair.

COTTON IN EGYPT.

512. Note on Spinning Value of New Egyptian Cottons. By W. L. Balls. (*Int. Cott. Bull.*, x., **39**, 1932, p. 388.) The principal new Egyptian varieties of importance to spinners are Giza 7, Maarad, and Sakha 4. All these have agricultural qualities which will probably lead to an increased area of them being sown. Giza 7 is a cotton shorter than Sakel, and slightly coarser, but stronger. It is lighter in colour than Sakel and has an excellent lustre. At 100's, Giza 7 makes a yarn a few pounds weaker than Sakel. This is probably the highest count at which it should be used. At lower counts its fibre strength should make it give a yarn approaching Sakel very closely. Maarad and Sakha 4 have some points in common. They are both longer than Sakel by 1 to 2 millimetres; they are, however, both weaker in intrinsic strength, and have not made quite equal yarn strength to Sakel in counts of 100 to 120. At higher counts, however, the extra length probably makes them approach more closely in yarn strength. Maarad and Sakha 4 are very distinct in colour, the former being almost as dark as Nahda, and the latter lighter than Sakel—*i.e.*, similar to Giza 7.

513. Maarad Cotton. (*Int. Cott. Bull.*, x., **39**, 1932, p. 393.) The area under this cotton has increased from 64 feddans in 1923 to 103,278 feddans in 1931, and the yield from 320 to 500,000 kantars.

COTTON IN THE UNITED STATES.

514. American Textile Notes. By W. Whittam. (*Text. Rec.*, l., **590**, 1932, p. 79.) In discussing the plight of the cotton grower, the author states that a table prepared by the Division of Statistical and Historical Research shows that in 1913, when the index number of prices paid by American farmers of all classes for farm implements, etc., stood at 100, the relative purchasing power of cotton was represented by 99, whereas in 1931 the former stood at 129 and cotton at 62. Another table shows that to buy a two-horse plough during the period 1910-14 required an average of 104 lb. of cotton, and that it required 286 lb. during June, 1931.

The movement for the reduction of acreage has had little effect, though Texas reports a cut of between 9 and 10 per cent. as compared with last season. There is the one encouraging circumstance that, with the exception of rayon, cotton was the only basic textile commodity that increased in world volume of consumption in the year 1931 over 1930.

It is also stated in the notes that mulch paper, which has been used for several years on a small scale by cotton growers as a means of keeping down weeds, holding moisture in the soil, and keeping the ground warm, is becoming more popular with the scientific type of farmer. Use on a commercial scale has demonstrated that this asphalte impregnated black paper, which lasts four years and saves its cost in one year, has in many cases reduced labour costs and increased the yield by over 90 per cent.

515. NON-AMERICAN COTTON: UTILIZATION IN THE UNITED STATES. By P. M. Strang. (*Text. World*, **81**, 1932, p. 1406. Abstr. from *Summ. of Curr. Lit.*, xii., 11, 1932, p. 331.) Particulars are given of the quantities of foreign cottons used in the U.S.A. The report is designed to guide home growers, and the following features are stressed. (1) The fact that a large quantity of 1⅛ inch cotton is imported implies some deficiencies in American cotton of this staple. (2) Staples from 1⅜ inches upwards are almost entirely imported. (3) About 55 per cent. of the Egyptian cotton imported is utilized by the rubber trade, about 25 per cent. by the thread trade, and the remainder for the mercerizing and fine trades. (4) The consumption of Peruvian cotton is declining, mainly because the tyre trade has almost ceased to use it. (5) The bulk of the Indian cotton imported is of less than ⅞ inch staple, and competes with Chinese cotton in the blanket trade.

516. MOISTURE IN AMERICAN COTTON. (*Int. Cott. Bull.*, x., **39**, 1932, p. 442.) That the 1931-32 American cotton crop is more moist than usual is further evidenced by the fact that the New Orleans Public Cotton Warehouse have installed a cotton-drying room which will dry 500 bales of cotton in a twenty-four-hour day. Details of the drying-room are given.

517. AMERICAN COTTON: PRICE IN RELATION TO WHOLESALE INDEX NUMBERS. (*M/c. Guar. Comml.*, **24**, 1932, p. 341. Abstr. from *Summ. of Curr. Lit.*, xii., **12**, 1932, p. 362.) Diagrams are given showing the course of the value per acre in dollars of American cotton, along with the index figure of wholesale prices, and also the percentage change in production of American cotton from the previous season, the percentage change in price, and the percentage change in index figure. The diversity and uncertainty of computation of index figures is briefly discussed.

518. CALIFORNIA. *Cotton Cultivation.* (*S. Calif. Crops*, viii., **8**, 1932.) Cotton has made good progress in most districts. Stands are still below normal, but plants are fruiting heavily and there has been almost a total absence of shedding. Conditions point to a fairly satisfactory yield if weather continues favourable.

519. MISSISSIPPI. *Agronomic Work in* 1931. By C. F. Briscoe *et al.* (*Miss. Sta. Rpt.*, 1931. Abstr. from *Exp. Sta. Rec.*, lxvi., **8**, 1932, p. 729.) The experiments with cotton included breeding work, inheritance studies, varietal trials, cultural and fertilizer trials, seed treatment tests, and crop rotations.

520. MISSISSIPPI STATION. *Fertilizer Experiments.* By L. E. Miles. (*Miss. Sta. Rpt.*, 1931. Abstr. from *Exp. Sta. Rec.*, 66, 8, 1932, p. 745.) Potash fertilizer applied to cotton growing on soil heavily infested with wilt decreased the wilt when used in moderate amounts and when well balanced with other elements. No significantly better results followed the use of large amounts of potash in relation to phosphorus and nitrogen, nor was wilt reduced further by increasing the total quantity of fertilizer applied. A deficiency of potash appeared to increase wilt more than did a deficiency of nitrate.

521. SOUTH CAROLINA. *Cotton Research.* (*S. Carol. Sta. Rpt.*, 1931. Abstr. from *Exp. Sta. Rec.*, 66, 7, 1932, p. 629.) Further investigations with cotton comprised variety, cultural, fertilizer, and cover crop tests; physiological and fibre studies, and seed treatments.

Continuing their study on factors influencing growth and development of cotton buds and bolls, G. M. Armstrong and W. B. Albert determined that defoliation of branches appreciably reduced the final size of bolls and average weights of seed and lint. Shedding of bolls increased as the result of early defoliation, ringing, or removal of leaves adjacent to fruit buds five to seven days before blooming. The experiments showed the great dependence of the boll on the green tissues adjacent to it, and also that transport of materials from a distance takes place.

In a study of the length and structure of fibres by H. W. Barre, Armstrong, and C. C. Bennett, the fibre arrays of individual seed suggested the possibility that the twenty-four to twenty-six groups of different lengths obtained may have been derived from the fibres which grow from the seed coat daily—*i.e.*, each group may have been produced roughly in a period of twenty-four hours. The fibres were found to grow very rapidly for the first week, and then less rapidly up to twenty-four to twenty-seven days, but were still elongating slowly at thirty days. The fibres at the large end of the seed were appreciably longer than those at the tip end. Although the longest fibres practically ceased growing at thirty days, the arrays showed that other fibres must continue to elongate until maturity of the boll at fifty days. That the shorter fibres at twenty-five days of age were not due to breakage of the immature fibres was shown by microscopic examination of many fibres of different lengths. The volume and surface area of the seed increases only very slightly after twenty-five days of age, suggesting that few new fibres are produced thereafter from the surface area. Conclusions were that the changes in the distribution of the different lengths of fibres from twenty-five to fifty days must be due to the increased growth in length of many of the shorter fibres.

The weights of 300 fibres of each length revealed that the short fibres are heaviest per unit length—*i.e.*, the longest fibre is the finest fibre. This holds in the boll twenty-five days old as well as in one fifty days old. The outer bolls on the limbs were found to have larger percentages of short fibres and were less uniform in distribution than bolls at the first position on the limbs. The arrays indicated that bolls with practically the same percentage of lint might vary considerably in the uniformity of the fibres. Rather striking variations in fuzziness of the seed coat were observed and studied.

Cultural and cover crop experiments were made at the Pee Dee Substation by E. E. Hall and S. J. Watson. Machine-delinted seed dusted with an organic mercury compound gave an increase in stand of 19·4 per cent. and acid delinted seed an increase of 37 per cent., whilst other dusts with varying strengths gave results ranging from a decrease of 6·2 per cent. to an increase of 21·2 per cent. Hairy vetch and monantha vetch led cover crops in the production of nitrogen for cotton.

COTTON IN FOREIGN COUNTRIES.

522. ARGENTINA. *Cotton Production,* 1931-32. (*Int. Cott. Bull.,* x., **40,** 1932, p. 491.) The area planted to cotton for the 1931-32 season was estimated at 173,000 hectares of approximately 2½ acres each, as against 171,000 hectares for the 1930-31 season. It is believed that the crop will amount to from 160,000 to 180,000 bales of 500 lb., compared with 145,000 bales for the previous season.

523. BELGIAN CONGO. *Cotton Cultivation,* 1930-31. By F. Sparano. (Abstr. from *Int. Rev. Agr.,* xxiii., **5,** Rome, 1932, p. 171.) This season, like the preceding one, marked a decided advance in cotton production. The results would have been still better if weather conditions had been more propitious and the damage from disease and pests less. Blackarm disease and pink bollworm caused the most damage. The native is taking more interest in cotton cultivation, and European planters are also interested in it. The seed improvement scheme is being systematically carried on at the selection stations. A total of 908,762 kg. of selected seed has been produced.

524. CHINA. *Cotton Production.* (*Int. Cott. Bull.,* x., **39,** 1932, p. 355.) The fertile plains north and east of Tientsin, watered by the North and East Rivers, form one of the most important cotton-growing districts in Hopei. The variety originally grown was known as "small black seed," but at present most of the fields are planted with American cotton, which gives nearly twice as large a yield. Since 1915 several cotton mills have been erected in Tangshan and Tientsin, and the demand for long-staple cotton has reached such a degree that the farmers are extending their cotton fields and local production is showing rapid development.

525. ASSOCIATION COTONNIÈRE COLONIALE. In *Bull. No.* 7, the articles by J. Risbec, "Le cotonnier dans les îles françaises du Pacifique Austral," and E. Achard, "Les conditions de la culture du coton en Syrie," are concluded. The annual report of the General Manager, M. Hesling, and the Treasurer, M. Meunier, are presented, and in addition there are short papers on a visit to Syria (M. Derulle), and on Ishan cotton in the Ivory Coast. The usual notes on cotton in the French Colonies are included.

526. COTTON GROWING IN HAITI. By D. R. Heath. (*Int. Cot. Bull.,* x., **40,** 1932, p. 489.) Four species of cotton are known on the island: *Gossypium vitifolium, G. barbadense, G. purpurascens,* and the brown cotton *Gossypium var. religiosum.* The paper deals with acreage and production, development of an improved Sea Island type, prospects of increased cultivation of long-staple cotton, labour facilities, climatic conditions, and pests and diseases.

527. IL DEPERIMENTO DELLE PIANTAGIONA DI COTONE NELLA SOMALIA ITALIANA. By G. Russo. (*Agr. Colon.,* xxvi., **1-3,** Florence, 1931. Abstr. from *Rev. App. Ent.,* xx., Ser. A, **6,** 1932, p. 339.) In this report, based on work in experimental plots and in the field, the decline of cotton plantations in Italian Somaliland is ascribed to a complex of ecological, biological, and cultural factors, which are discussed.

528. JAPAN. *Cotton Industry,* 1931. (*Anglo-Gujarati Qrtrly. Jour. of Ind. Merchants' Cham.,* July, 1932.) Deals with general conditions in the industry in 1930, mill operations, yarn and cloth production, and exports in 1931.

529. PERU. *Cotton Production,* 1931-32. (*Int. Cott. Bull.,* x., **40,** 1932, p. 495.) The 1931-32 cotton crop is estimated by the National Agrarian Society of Peru at about 204,000 bales of 500 lb. compared with 225,000 bales for the previous season. It is believed that the 1932-33 crop will be slightly larger. Cotton growers consider that their condition has been somewhat relieved by the recent depreciation of the Peruvian currency, inasmuch as the prices they receive are based on sterling or dollars.

530. COTTON GROWING IN THE SOVIET UNION. By S. S. Shipman. (*Cott. and Cott. Oil News.* Abstr. from *Int. Cott. Bull.*, x., **39**, 1932, p. 351.) An interesting short account showing what has been accomplished.

531. RUSSIAN TEXTILE INDUSTRY: DEVELOPMENT. By H. A. Robiczek and R. Leonhardt. (*Text. World*, **81**, 1932, p. 1172. Abstr. from *Jour. of Text. Inst.*, xxiii., **6**, 1932, A.358.) The remarkable growth of the Russian textile industry during 1929 and 1930 is discussed, and tables are given showing the textile machinery imported in 1929 and 1930, and the production in 1930 and 1931.

532. TEXTILE INDUSTRY IN U.S.S.R. (*Int. Cott. Bull.*, x., **39**, 1932, p. 431.) Gives statistics showing, *inter alia*, the increase in the area planted to flax, hemp, and cotton since 1925, the value of the textile machinery in operation in the first and second quarters of 1931, the value of the textile machinery imported into U.S.S.R. in 1929 and 1930, the rise in production of textile manufactures in 1931 as compared with 1930.

533. EGYPTIAN COTTON SEED: VACUUM FUMIGATION IN RUSSIA. By A. D. Petrov *et al.* (*Chem. Abs.*, **26**, 1932, p. 1379. Abstr. from *Summ. of Curr. Lit.*, xii., **10**, 1932, p. 286.) Egyptian cotton seed was fumigated with varying quantities of hydrogen cyanide, and the amount of hydrogen cyanide absorbed by various parts of the seed was studied. The best conditions for fumigation were investigated. Experiments are described in detail.

SOILS AND MANURES.

534. PRINCIPLES OF SOIL MICROBIOLOGY. By S. A. Waksman. (London. Baillière, Tindall and Cox, 1931. Abstr. from *Rev. App. Mycol.*, xi., **7**, 1932, p. 470.) Although only four years have elapsed since the publication of the first edition of this standard work, a number of changes were necessitated by the many contributions to the knowledge of the subject made during this period. To bring the book up to date some of the chapters have been entirely rewritten, especially those dealing with the mycorrhizal fungi and the soil as a medium for plant and animal parasites. New chapters have been added treating of the rôle of micro-organisms in the decomposition of organic matter in green and stable manure, the relation between plant growth and the activities of soil micro-organisms, etc. As in the previous edition, the interdependence between the activities of micro-organisms and the chemical transformations in the soil is specially emphasized.

[*Cf.* Abstr. **63**, Vol. V., p. 71, of this Review.]

535. THE INFLUENCE OF THE PLANT UPON SEASONAL CHANGES IN SOIL ACIDITY. By A. M. Smith and I. M. Robertson. (*J. Agr. Sci.*, **21**, 1931, p. 822.) Observations made on different soils in incubation, pot, and field experiments show that the acidity of the soil increases to a maximum during the growing season. The change may be more than one pH unit on uncropped soil, but the presence of plants reduces that change so that at the height of the growth there is a considerable difference between the acidity of the cropped and that of the uncropped soil. That difference disappears at the end of the growing season when the acidity of the soil approaches the value for the beginning of the season. The effects of climatic factors and concentration of soil electrolytes are discussed.

536. LATERITE AND LATERITE SOILS. (*Tech. Commn. No.* 24, Imp. Bur. of Soil Sci., Rothamsted, 1932.) The name "laterite," which Buchanan used in 1807 to denote deposits of indurated clay in India, has been applied by geologists and others to so many kinds of ferruginous deposits found in the tropics that its original significance has been lost. In recent years the word has been applied more particularly to a weathered rock product formed by the leaching of igneous and metamorphic rocks whereby the bases and much of the silica are removed, leaving a residue containing alumina uncombined with silica. It is in this sense that laterite is defined and used in these notes.

Studies of rock weathering in the tropics show that under conditions of intense leaching laterization takes place *in situ*. The rock passes directly into a weathered product in which the alumina, in excess of that required to combine chemically with the silica (excluding quartz or secondary silica), is present chiefly in the form of gibbsite. The presence of " free " alumina is reflected in characteristically low silica/alumina ratios.

The following characteristics also appear in some laterites: the formation of successive layers of laterized material contiguous to the parent rock, retaining its structure; a slaggy appearance due to the secondary deposition of iron oxides, alumina, and silica from solution; a vesicular structure, which may be partly due to the selective action of the leaching on the minerals in the rock; and a deep red, orange, or red brown colour due to a high content of hydrated iron oxides.

In general, the essential conditions for laterite formation appear to be: (*a*) Intense rainfall; intermittent rainfall (alternation of wet and dry periods) opposes laterization through the resilication of the hydrated alumina formed through leaching. A change in the conditions of drainage and a rise of the ground water level also bring about resilication. (*b*) A high temperature, which prevents the accumulation of humus and therefore the formation of humic acids capable of bringing iron oxides and alumina into solution. Laterization or silica leaching may be regarded as the antithesis of sesquioxide leaching (podsolization). (*c*) The presence of the more basic minerals in the parent rock. Basic rocks laterize more readily than acidic rocks; the latter tend to weather to kaolin rather than to gibbsite.

Laterite soils are formed both *in situ* over the parent rock and from eroded detrital laterite material. Harrison's examination of the profiles of soils derived from both basic and acidic rocks showed a decrease in the ratio of combined silica to sesquioxides, alumina, and combined water respectively, from the parent rock to the weathered material in contact with it—a decrease which was relatively greater in the basic profile. In the basic profile gibbsite was present and kaolin absent in the layer contiguous with the rock; in the acidic profile gibbsite was absent and kaolin present. Resilication caused by capillary rise and changes in the ground water level appears to affect the basic profiles more than the acidic profiles, and this tends to make the silica/alumina ratios of the two profiles similar and ultimately to produce similar soils. Martin and Doyne have described lateritic soils formed *in situ* and from detrital laterite material. In the latter, undecomposed mineral fragments undergo further laterization, and the whole may acquire a characteristic concretionary structure through cementation with iron oxides. Under certain drainage conditions laterite pans are formed.

Definition of laterite soils: Martin and Doyne consider that " free " alumina is the essential constituent of laterite and laterite soils, and that its amount, and therefore the degree of laterization, is indicated by the silica-alumina ratio. Soils in which the ratio is 1·33 or less they call laterite soils. Ratios between 1·33 and 2·0 indicate lateritic soils, ratios above 2·0, non-lateritic soils. These limits are provisional and are based on the examination of soils in Sierra Leone. The silica-alumina ratios are determined in the clay fraction of the soil only. In a paper based on Harrison's studies of rock weathering in British Guiana, Hardy and Follett-Smith advocate the chemical examination of the whole soil through the profile, from the top soil to the parent rock—Harrison took about twenty samples from each profile—and the determination of combined silica and of quartz. As a rapid means of determining whether laterization has taken place they estimate alumina (and iron oxides) uncombined with silica by means of an alizarin adsorption method.

Judged by Martin and Doyne's definition, most of the soils reported as laterite or lateritic would belong to the lateritic type, though few have silica/alumina ratios in the clay indicating true laterite soils. A silica/alumina ratio lower than that of kaolin (2·0) rarely occurs in soils other than those formed under conditions of excessive leaching—*i.e.*, in areas of high rainfall. Partial laterization accounts for ratios higher than 2·0 occurring in soils which are probably true laterite soils. Possibly the most accurate classification would be one based on the examination of the complete soil profile, and the determination of the amount of hydrated alumina in the soil.

Compared with soils of high silica/alumina ratio, soils of the lateritic type differ markedly in physical properties. Such differences are probably due to the nature rather than to the amount of the colloidal matter in the soil. A high degree of porosity is characteristic of many laterite soils.

537. RELATIONS OF BUFFER CAPACITY FOR ACIDS TO BASICITY AND EXCHANGEABLE BASES OF THE SOIL. By G. S. Fraps and J. F. Fudge. (*Bull. No.* 442, Texas Agr. Exp. Sta., 1932.) Methods of measuring buffer capacity are studied, together with the relation of the buffer capacity to the carbonates, to exchangeable bases, and to other properties of the soil. The present study originated in connection with the study of the possibility of making certain soils sufficiently acid by treatment with sulphur to inhibit the growth of the organism causing the cotton root-rot disease.

538. VARIATIONS IN MOISTURE AND NITRATE CONTENT OF FIELD SOILS RECEIVING DIFFERENT METHODS OF CULTIVATION. By R. P. Bartholomew. (*Bull. No.* 270, Univ. of Arkansas, 1932.) Gives the results of seven different methods of cultivation used on cropped and uncropped soil to determine how much the method of cultivation would influence the nitrate and moisture content of soils. In addition, experiments were carried out to determine the winter losses of nitrate nitrogen from the soil. The efficiency of cover crops in conserving available nitrogen was also studied.

539. THE PRESENT POSITION OF THE USE OF FERTILIZERS. By E. M. Crowther. (*J. of Roy. Agr. Soc. of Eng.*, vol. 92, 1931.) An interesting survey of the past development and the present position of the agricultural use of fertilizers. The rates of fertilizer consumption, the effect of fertilizers on crop yields, and the phenomenally rapid expansion of the synthetic nitrogen industry are dealt with.

540. FERTILIZERS FOR COTTON SOILS. By J. J. Skinner. (*U.S. Dpt. Agr. Misc. Pub.* 126, 1931. Abstr. from *Exp. Sta. Rec.*, 66, 6, 1932, p. 529.) Practical information on the use of fertilizers in growing cotton, based extensively on the research work of experiment stations in the Southern States and the U.S. Dept. of Agriculture, covers the analysis and composition of fertilizers for cotton soils, and rates, time, and methods of applying fertilizers for cotton.

541. COMBINED AND CONCENTRATED FERTILIZERS. By H. Vergnaud. (*Congr. Trop. Agr. Paris*, 1931, F. 33. Abstr. from *Tech. Commn. No.* 21, Imp. Bur. of. Soil Sci., Rothamsted, 1931.) Artificial fertilizers are described under the appropriate combinations of N + P + K; N + P; N + K. The following are mentioned: Nitrophoska, ammonium phosphates, potassium phosphate, potassium nitrate, Potazote, Nitropotazote, Nitropotasse, Nitrochalk, Kalkammon saltpetre, ammonitre. Formulæ are given for the amounts of N, P, K necessary for the following crops: cotton, coffee, citrus, sugar-cane, and tobacco.

542. EFFECTS ON COTTON OF IRREGULAR DISTRIBUTION OF FERTILIZERS. By A. L. Mehring and G. A. Cumings. (*J. of Agr. Res.*, 44, 7, 1932, p. 559.) Ordinary and concentrated fertilizers at rates of 800 and 267 lb. per acre respectively were applied uniformly by hand, and with five typical degrees of irregular distribution by commercial distributors in narrow bands 2 inches below cotton-seed in Norfolk coarse sand and Cecil sandy clay loam. A statistical analysis was made of measurements of the crops produced. The results indicate that a larger number of seeds germinate promptly, but the seedlings are more irregularly spaced along the row when fertilizers are irregularly applied than when they are uniformly distributed. More rapid and uniform growth, earlier blooms, earlier maturity, and larger yields of cotton were produced by uniform applications than by irregular ones. The extent of these effects was decidedly significant, and varied with the degree of irregularity of distribution.

543. THE EFFECT OF INCREASING CONCENTRATIONS OF SALTS ON THE GROWTH OF COTTON IN CULTURE SOLUTIONS. By A. F. Pankratova-Glagoleva. (*Report of the Scientific Research Institute of Cotton Culture and Industry* (*NIHI*), Moscow and Tashkent, 1932. Pp. 24.) In experiments at Tashkent in 1926-27, the addition of sodium chloride to give a concentration of 0·37 per cent. or more greatly reduced the growth of cotton in Hellriegel's culture solutions and in sand cultures. The addition of small proportions of potassium and calcium chlorides gave no improvement, and for equal total molecular concentrations the mixture of these salts proved more harmful than sodium chloride only. In soil cultures, sodium chloride, in amounts not exceeding 0·73 per cent. of the soil solution, slightly increased growth; the harmful effects of higher concentrations of sodium chloride were mitigated to some extent by the antagonistic action of potassium and calcium chlorides, giving two molecules of each salt per hundred of sodium chloride.

[*Cf.* Abstract **502.**]

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

544. LE COTONNIER: II. MÉTHODES CULTURALES, CULTURE ANNUELLE, CULTURE PERENNANTE, CULTURE PROPREMENT DITE. By Ray C. P. Boone. (Soc. d'Éditions Géographiques, Maritimes et Coloniales, Paris, 1930. Abstr. from *Bull. Imp. Inst.*, xxix., **1**, 1931, p. 96.) This volume is devoted mainly to problems concerned with the cultivation and harvesting of cotton. Attention is also given to the rotation of crops, manuring, harvesting, and yields. The book is copiously illustrated and contains an extensive bibliography.

545. LE COTONNIER: III. ÉGRENAGE ET PRESSAGE DU COTON, CONDITIONNEMENT ET TARE DES BALLES DE COTON, ÉTUDE ÉCONOMIQUE SUR L'INDUSTRIE DE L'ÉGRENAGE, SYSTÈME DE COMPTABILITÉ POUR USINES D'ÉGRENAGE. By Ray C. P. Boone. (Soc. d'Éditions Géographiques, Maritimes et Coloniales, Paris, 1932. Abstr. from *Bull. Imp. Inst.*, xxx., **2**, 1932, p. 250.) Deals with the various stages through which the raw cotton passes from its arrival at the ginnery to its exit in the form of bales. After referring to the storage of the seed cotton, the author describes in great detail the two classes of ginning machines—roller and saw gins. An account is given of the machinery used to clean seed cotton before it enters the gin, and full particulars are supplied regarding de-lintering. Information is furnished regarding the most modern types of ginneries, the modes of operating them, and the different kinds of baling presses.

The work concludes with an economic study of the methods of accounting adopted in the ginneries of the United States. The book has been written in a most complete and thorough manner, is profusely illustrated, and contains a useful bibliography.

546. TREATING COTTON SEED BY THE DUSTING METHOD. By N. C. Woodroof. (*Ga. Sta. Bull.* 170., 1931. Abstr. from *Exp. Sta. Rec.*, 66, **8**, 1932, p. 747.) Many of the ninety-four chemicals tested were found to be unsatisfactory. Mercury compounds were the best adapted for disinfecting cotton seed. Copper compounds and coal tar products were unsuitable. The average percentage increase in germination from the highest yielding dust treatment for each year was 8·28 per cent. above the untreated check. The increase over delinted seed averaged 10·13 per cent. The average increases in yield from the leading dust treatment over the untreated check and over the acid-treated delinted lot amounted to 140 and 187·1 lb. of seed cotton respectively. The benefits of seed treatment were greater in years when cold wet weather followed planting. Ceresan applied at the rate of 4 oz. per bushel gave promising results. A home-made duster is described.

547. MATHEMATICAL STUDY OF FIELD EXPERIMENT METHODS FROM THE DATA OF THE FERTILIZER STATION. By V. Peregundov. (*Transactions of the Central Asia Fertilizer Station. Proceedings of the All-Union Scientific Research Institute of Cotton Culture and Industry* (*NIHI*). Tashkent, U.S.S.R. Issue 35, 1931. Pp. 59. In Russian, with a short and inadequate English summary.) An attempt was made to ascertain whether sufficient accuracy could be obtained in field experiments with a few relatively large plots (200 sq. metres) by using correcting factors based on correlations either between the yields on individual plots in successive seasons or between adjacent plots. It was concluded that such correlations are much too small to be useful, and that precision in field experiments is to be attained only by having considerable replication in random arrangement or with restrictions (*e.g.*, as in the Latin Square) of the type developed by Dr. R. A. Fisher at Rothamsted.

548. THE CALCULATION OF THE OPTIMAL DENSITY OF SOWING. By M. Eidelnant. (*Transactions of the Tashkent Section of Selection. Proceedings of the Scientific Research Institute of Cotton Culture, Industry, and Irrigation* (*NIHI*), Tashkent, U.S.S.R. Issue 46, 1931. In Russian, with a short and inadequate summary in English.) The following new general relationship between the crop yield (u) and the amount of one growth factor (x) is proposed:

$$u = A + B \log x + Cx^p$$

where A, B, C and p are constants. The formula is simplified for experiments on plant density, and for a yield of u from n plants per unit area the equation suggested is—

$$u = A + B \log n + Cn.$$

The processes of fitting this equation and estimating the goodness of fit are discussed in detail and illustrated for some wheat experiments.

549. MODERN METHODS OF FIELD EXPERIMENTATION. By C. H. Goulden. (*Sci. Agr.*, xi., **10**, 1931, p. 681. Abstr. from *Exp. Sta. Rec.*, 66, **5**, 1932, p. 425.) Methods of conducting field experiments as developed at the Rothamsted Experimental Station by R. A. Fisher and associates are outlined, with particular attention to methods of calculation. Discussion is accorded general principles, randomized experiments, calculations and formulas for analysis of variance tests

complex experiments, analysis of variance applied to seasonal effects in field experiments, and the shape of field plats.

550. COMMON ERRORS IN COTTON PRODUCTION. By O. F. Cook. (*U.S. Dpt. Agr. Farmers' Bull.*, 1686, 1932. Abstr. from *Exp. Sta. Rec.*, 66, 8, 1932, p. 733.) The chief defects in cotton production in the United States are summarized, with constructive suggestions for improvement. General improvement measures include the production of single varieties on a community scale and a change in the method of buying cotton so as to give a higher return for better quality. Some causes of inferior cotton are planting poor seed, planting on price conjectures, changing the seed, planting too many varieties, failure to test varieties, misleading claims for varieties, propagating hybrids, unsuitable land, planting or thinning too early, spacing too wide, picking too late, breeding weevils in the fall, mixing the seed at public gins, and ginning too close, too wet, or too dry.

551. RESULTS OF COTTON VARIETIES TRIALS IN 1930. By I. Varuntsian and A. Inozemtsev. (*Transcaucasian Cott. Res. Inst., Zaknihi, Tiflis*, 1932.) The varietal trials have been continued, and new strains are in process of development, suitable to the region and with staple of from 28-30 mm.

552. PRELIMINARY EXPERIMENTS ON THE USE OF MULCH PAPER IN COTTON CULTURE. By I. S. Varuntsian. (*Transcaucasian Cott. Res. Inst., Zaknihi, Tiflis*, 1932, Issue 17.) (In Russian, with a summary in English.) Describes experiments carried out in 1930 on the use of mulch paper as a means of preserving soil moisture and also of effecting weed control. The mulched soil has a slightly lower temperature near the surface than the unmulched. Wind offers difficulties, and ways of overcoming them are dealt with. It is stated that roofing paper, as containing toxic volatile compounds, is not fit for mulching in cotton culture. The use of mulch paper solves the problem of preventing the formation of alkali crust on the soil surface, since the crust cannot form under the paper.

553. A STUDY OF AMMONIA AND NITRATE NITROGEN FOR COTTON. I. INFLUENCE ON ABSORPTION OF OTHER ELEMENTS. By K. T. Holley *et al.* (*Bull.* 169, *Ga. Agr. Exp. Sta.*, 1931.) In these experiments cotton plants produced more dry matter in nitrate nitrogen solutions than in ammonia nitrogen solutions, good growth being obtained in each case. The nitrate plants grew faster in the first two or three weeks, but the difference in dry matter as compared with ammonia plants was less at from five to six weeks than at other stages of growth. Under unfavourable growing conditions in a six-weeks period, with a high concentration of nitrogen in the solution, ammonia plants had a very high nitrogen content. In favourable growing conditions with lower nitrogen concentration in the solutions there was little difference at thirteen weeks between nitrate and ammonia plants in total nitrogen content of plants of either series, but there was some variation in its distribution in roots, stems, and leaves. The use of the ammonia ion as a source of nitrogen reduced the adsorption of bases, the greatest effect being on calcium and magnesium. In the case of magnesium it was cumulative. Though the ammonia ion reduced calcium absorption, there was no evidence that calcium reduced the absorption of ammonia nitrogen. While differences in calcium content of ammonia and nitrate plants were due principally to leaf calcium content, the differences in magnesium content were evident in roots, stems, and leaves. The ammonia plants had a tendency to absorb relatively more sulphur and phosphorus in the early stages, but there was a shift in relative rates of absorption of these elements in later stages, the nitrate plants tending to absorb them slightly more rapidly after the inception of the fruiting stage.

554. GROWING COTTON AND OTHER PLANTS WITH AMMONIUM NITROGEN. By V. A. Tiedjens. (*Sci.*, **75**, June 17, 1932, p. 648.) A criticism of the interpretation often given to Willis and Rankin's work, that in general (not only in their special case) ammonia fertilizers are toxic to cotton plants. This position the author considers untenable.

555. THE WATER RELATION TO COTTON PLANT IN MANCHURIA. I. TRANSPIRATION AND WATER REQUIREMENT (trans. title). By S. Terada and K. Yoshitake. (*Res. Bull. Agr. Exp. Sta. So. Manchuria Ry. Co., No.* 3, 1931. Abstr. from *Exp. Sta. Rec.*, 66, **6**, 1932, p. 518.) Experimental data are given and summarized for tests made of the relation between transpiration and a few climatic elements, and the measurement of water requirement of two indigenous cottons (a naked and a fuzzy seeded variety) and the Upland Turkestan 1306.

556. THE POWER UNIT AS A FACTOR IN PRODUCTION COSTS OF CORN AND COTTON. By C. S. Patrick. (*S. Car. Sta. Rpt.*, 1931. Abstr. from *Exp. Sta. Rec.*, 66, **7**, 1932, p. 679.) Thirty-four acres of cotton and forty acres of corn were divided into four plats each and prepared, planted, and cultivated, using the following power units: With one animal, with two or more animals, with tractor, and with the unit which at the time of the operation seemed most desirable. Tables are given showing the production cost per acre, by items, and the yield per acre on the several plats.

557. CALCULATION OF PROBABLE ERROR OF MENDELIAN RATIOS. By B. B. Mundkur. (*Ind. Jour. of Agr. Sci.*, II., Pt. I., 1932, p. 42.) The probable error of Mendelian ratios can be determined in three ways: the method of absolute numbers, the method of percentages, and the method of ratios. The method commonly used by geneticists is the method of absolute numbers, and this is described in the paper for the benefit of Indian plant breeders.

558. A STATISTICAL NOTE ON THE METHOD OF COMPARING MEAN VALUES BASED ON SMALL SAMPLES. By P. C. Mahalanobis. (*Ind. Jour. of Agr. Sci.*, II., Pt. I., February, 1932, p. 28.)

559. SOME ASPECTS OF THE ROTATION "WHEAT-WHEAT-TORIA-COTTON" AT THE LYALLPUR AGRICULTURAL FARM. By C. N. Alam. (Abstr. from *Seasonal Notes, Punjab Agr. Dpt.*, ix., **1**, 1932, p. 43.) Experiments showed that although the rotation wheat-wheat-toria-cotton was a very exhaustive one, the yields can be fairly well maintained by the addition of 8 tons of farmyard manure per acre once in four years.

560. CROP ROTATION AND TILLAGE EXPERIMENTS AT THE SAN ANTONIO (TEXAS) FIELD STATION. By G. T. Ratliffe and I. M. Atkins. (*U.S. Dept. Agr. Circ.* 193, 1931. Abstr. from *Exp. Sta. Rec.*, 66, **7**, 1932, p. 628.) Cotton yields generally were higher in rotations than under continuous cropping. Rotations longer than two years did not appear more productive than two-year cycles. Cotton yields were low following sorghum, especially in two-year rotations of these crops. Records on cotton root rot disease indicated that of all the crop-sequences and cultural practices included in the rotation experiments, increasing the time between the recurrence of cotton in the cycle is the most effective factor in reducing the loss from this disease. Root rot was much more destructive in continuous cropping than in rotations, and was more extensive in two-year rotations than in three-year and four-year rotations.

561. COTTON PLANT: INFLUENCE OF METHODS OF IRRIGATION ON YIELD. By F. V. Gelitzer. (*Chem. Abs.*, **26**, 1932, p. 1693. Abstr. from *Summ. of Curr.*

Lit., xii., **11**, 1932, p. 312.) Infiltration by furrow irrigation was found to preserve the structure of the soil and to provide, in comparison with irrigation by flooding, better aeration which increases the carbon dioxide content of the air immediately above the soil. It also increases the nitrate content 30 to 40 per cent. more than under flooding practices, and affords a greater utilization of it by the plants. Nitrification increases and denitrification decreases, and parallel with the availability of nitrate there is an increase of other mineral elements which in turn increase the yield.

562. COTTON VARIETIES UNDER VARIOUS CONDITIONS OF IRRIGATION. By I. Varuntsian and A. Staroselskaja. (*Transcaucasian Cott. Res. Inst., Gandja, Azerbaijan, U.S.S.R.*, 1932, Issue 19.) An interesting account of the results of different degrees of irrigation on cotton yield. The most drought-resistant cottons are the early varieties, the resistance diminishing with the later varieties. The results are discussed with reference to conditions in Turkestan.

563. COTTON HARVESTING MACHINE. Cotton Harvester Corporation of America. (Pittsburgh, Penn., U.S.A. E.P. 368,732 of 21/5/30. Abstr. from *Summ. of Curr. Lit.*, xii., **8**, 1932, p. 223.) A cotton harvester comprises in combination a 'revolubly' mounted picking needle carrier; a carrier-supporting structure rigidly connected with the carrier, and concentric with its axis of revolution; driving means; means whereby the supporting structure engages the driving means for revolving the carrier; picking needles rotatably mounted in rows in the needle carrier; means for independently actuating each row to rotate the needles in it for a portion of each revolution of the needle carrier, comprising vertical shafts each providing an actuating connection for a row of needles and each having a separate engaging clutch associated with each individual row of needles; and means in constant contact with and arranged to act on the engaging clutch operatively to complete the actuating connection of each individual row of needles during a portion of each revolution of the needle carrier.

564. EFFECT OF GINNING METHODS ON COTTON FIBRE QUALITY STUDIED. (*Off. Rec. U.S. Dpt. of Agr.*, x., **32**, 1931. Abstr. from *Ind. Jour. of Agr. Sci.*, ii., **1**, 1932, p. 98.) Ginning may seriously affect the grade and staple of cotton that contains too much moisture, according to studies made at the cotton ginning laboratory at Stoneville, Miss., and in the cotton fibre research laboratories at Washington, D.C. Too rapid operation of the gin will also injure the fibre. In explaining these observations, F. L. Gerdes, fibre technologist of the Bureau of Agricultural Economics, says: " Studies of the effects of ginning methods were begun as a result of protests received by the department from the cotton industry in this country, and abroad, to the effect that the preparation of American cotton is not as good as it used to be—that is, the cotton is rougher and more neppy than formerly." Preliminary studies indicate that successful cleaning and extracting depend on the moisture content of seed cotton. Excessive moisture causes, among other things, a loss or shortening of fibre lengths and a lowering of grade. It also affects the preparation. It is stated that inferior preparation of cotton in the Delta of the Mississippi is usually the result of ginning early, green, sappy cotton, and late rain-soaked cotton without proper conditioning, and of operating the gins at full capacity on long-staple cotton. Even if a long-staple cotton has a so-called normal moisture content, preparation may be inferior if it is ginned too fast. By improved machines and methods, the fibres of samples are sorted according to length. A comparison of the weight percentages of the different fibre lengths of samples ginned in various ways, Mr. Gerdes states, will show the best ginning conditions for any given cotton. Results obtained by measuring the colour of cotton can be converted into terms of grade.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

565. FUNDAMENTALS OF INSECT LIFE. By C. L. Metcalf and W. P. Flint. (McGraw-Hill Book Co., New York and London, 1932. Abstr. from *J. of Econ. Ent.*, xxv., **3**, 1932, p. 736.) This volume, in addition to a general account of the economic relation of insects to man, a discussion of insect structure and relations, brief descriptions of the more important groups, also gives an insight into the place insects occupy in the animal kingdom, and an idea of the way they react to their environment. The authors in bringing together this digest have shown excellent judgment in the selection of material, and have produced a work which is not only attractive, but has a wide range of usefulness for the numerous students of natural history. There is a well-selected, classified bibliography.

566. THE INSECT MENACE. By L. O. Howard. (The Century Co., New York and London, 1931. Price 12s. 6d. net. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **6**, 1932, p. 358.) The author describes the object of this interesting book as an attempt to arouse the public to an appreciation of the real and increasing menace to humanity that exists in the insect kingdom. The history and evolution of the various types of insects are traced from earliest times; the natural advantages of insects in the struggle for survival and the impetus to their increase that is given by civilization are described; and the growing use of weapons of defence, including biological control, chemicals, aeroplanes, quarantines and variations in crop practices, are discussed.

567. THE CONTROL OF PESTS OF COTTON. By D. Goloviznin *et al.* (In Russian.) (Mater. 1st All-Union Avio-Chem. Conf., Moscow, 1930. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **7**, 1932, p. 390.) Tests carried out in the former Syr-Daria Province in southern Kazakstan showed that aeroplanes could be used for dusting with flowers of sulphur against *Tetranychus telarius*, nicotine against Aphids, and calcium arsenate against *Heliothis obsoleta* and *Laphygma* (*Caradrina*) *exigua*, the most effective results being generally obtained by flying at a height not exceeding 17 feet, though the altitude depends on the nature of the insecticide and the strength of the wind, and may vary from about 10 to 32 feet. In a working day of six to eight hours it was possible to cover an area of about 400 acres, releasing 18 lb. of dust to the acre. The best time for the work was from 4 to 10 a.m. and 8 to 10 p.m.

568. PLANT PESTS IN CIRENAICA. (*Int. Rev. of Agr.*, xxiii., **4**, 1932, p. M53.) *Earias chlorana* and *E. anthophilana*. Caterpillars of these two species destroyed numbers of cotton bolls in the experimental plots of the Agricultural Services of Cirenaica.

569. CONFRONTI ENTOMOLOGICI, PER LA COLTURA DEL COTONE, TRA LA COLONIA ERITREA E LA SOMALIA ITALIANA. By A. Chiaromonte. (*Atti. lo Cong. Studi. colon., Firenze*, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **7**, 1932, p. 394.) An entomological comparison, regarding cotton cultivation, between Eritrea and Italian Somaliland.

570. NOTE INTORNO ALLA BIOLOGIA DEGLI INSETTI PIU IMPORTANTI PER LA COLTIVAZIONE DEL COTONE NELLA SOMALIA ITALIANA. By A. Chiaromonte. (*Atti. lo Cong. Studi. colon., Firenze*, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **7**, 1932, p. 393.) Notes on the biology of the more important insects observed on cotton in Italian Somaliland from November, 1925, to November, 1926.

571. SOUTHERN RHODESIA. *Cotton Pests*, 1931. (*Rhod. Agr. J.*, xxix., 7, 1932, p. 523.) The chief pests encountered during the year were the American, spiny, and Sudan bollworms, jassid, and cotton stainers. The greatest injury was caused by spiny and Sudan bollworms and cotton stainers, the latter being widespread and numerous, especially on ratooned cotton.

572. TANGANYIKA. *Cotton Pests in* 1930. (*Ann. Rpt. of Dpt. of Agr.*, 1930.) The chief pests causing injury during the year were pink bollworm, *Chloridea obsoleta*, and *Earias* spp. Stainer attack was exceptionally slight. Various minor pests, including *Anoplocnemis curvipes*, *Dilpognatha silicea*, *Hotea subfaciata*, *Macroraphis spurcata*, and *Tragocephala variegata*, were also noticed on cotton.

573. FEEDING PUNCTURES OF MIRIDS AND OTHER PLANT-SUCKING INSECTS AND THEIR EFFECT ON COTTON. By W. V. King and W. S. Cook. (*Tech. Bull. U.S. Dpt. Agr.*, *No.* 296, Washington, D.C., 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A, 7, 1932, p. 404.) A detailed description of experiments carried out in Louisiana during three years for the purpose of studying the lesions produced in stems and petioles of cotton by *Psallus seriatus*, Reut., and other plant-sucking insects, and determining whether they were due to a transmissible virus or to chemical injury. The character of the lesions caused by the feeding is described in detail.

The following is taken from the author's summary: Practically all punctures resulted in the same type of internal injury; lesions that swelled and broke open seemed to be the result of more extensive injury rather than injury of another kind. The feeding of ten different species (five Capsids, two Lygæids, two Jassids, and a Membracid), was observed. The average severity of the damage by different species was variable. The percentage of split lesions was 32·6 for *Lygus pratensis*, L., and 9·5 for *P. seriatus*. *Pœciloscytus basalis*, Reut., which is seldom taken on cotton, caused external swellings at every feeding point, and produced the highest percentage of split lesions (58·2). Of all the individuals that fed more than once, only two failed to produce the injury at some feeding point. The feeding punctures of the three species of Homoptera were traceable through the tissues by a well-defined sheath, similar in appearance to that observed in the case of Aphids, the paths usually ending in the vascular tissue. No sheath material was found about the punctures made by Capsids; at the most a few ruptured cells were observed. Since all the species tested cause a reaction in cotton stems similar to that produced by *P. seriatus*, the indications are that the damage is due to injected substances normally present in the insects and toxic to the plant, rather than to a transmissible disease.

574. REPORT OF THE CHIEF OF THE BUREAU OF ENTOMOLOGY, 1930-31. By C. L. Marlatt. (*U.S. Dpt. of Agr.*, *Washington*, *D.C.*, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, Pt. 4, 1932, p. 215.) In experiments in Texas, where the average feeding period of *Platyedra gossypiella*, Saund., within cotton bolls was 12·8 to 15 days, in no case did the larvæ enter the overwintering stage when the temperature averaged 77° F. or above. Below this, 17 to 68 per cent. entered the long-cycle hibernation stage. Striking proof was obtained of the efficiency of calcium arsenate dust in the control of the bollworm (*Heliothis obsoleta*, F.) on experimental plots of cotton, which received ten applications at intervals of five days, and of the importance of beginning dusting while the larvæ of the first generation are small.

575. SOUTH CAROLINA: STUDIES ON INSECT PESTS. (*44th Ann. Rpt. S. Car. Exp. Sta.*, 1930-31. Abstr. from *Rev. App. Ent.*, xx., Ser. A, 6, 1932, p. 355.) J. G. Watts found seedling cotton to be attacked by *Frankliniella tritici*, Fitch. Nine complete generations have been reared in the laboratory; the first four are present during the seedling stage of cotton. The average time required for the life-cycle was fourteen days, ranging from twenty-two days in early spring to nine in midsummer.

576. ABUNDANCE OF THE BOLL WEEVIL IN RELATION TO SUMMER WEATHER AND TO FOOD. By D. Isely. (*Bull. No.* 271, Univ. of Arkansas, 1932.)

577. INSECT ENEMIES OF THE COTTON BOLL WEEVIL. By E. F. Grossman. (*Fla. Ent.*, **15**, 1931, No. 1. Abstr. in *Exp. Sta. Rec.*, 66, **9**, 1932, p. 853.)

578. WINTER SURVIVAL OF IMMATURE STAGES OF THE BOLL WEEVIL. By E. F. Grossman. (*Fla. Ent.*, **15**, 1931, No. 1. Abstr. in *Exp. Sta. Rec.*, 66, **9**, 1932, p. 854.)

579. THE PINK BOLLWORM AND *Earias Insulana* BOISD., SPOTTED OR SPINY BOLLWORM. By V. V. Nikolskii and S. B. Radzievskaya. (In Russian.) (Union State Pub., Cent.-Asiat. Sect., Moscow, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **6**, 1932, p. 345.) Detailed information, based entirely on the literature, is given on the biology, geographical distribution, parasites, and control of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., and *Earias insulana*, Boisd., all stages of which are described, in view of the possibility of the introduction of these moths into the cotton-growing areas in the Russian Union. *P. gossypiella* has not been found in the Union, but *E. insulana* was recorded in 1930 from the Nakhichevan district in southern Transcaucasia.

580. PINK BOLLWORM: QUARANTINE REGULATIONS IN AMERICA. (Abstr. from *J. of Econ. Ent.*, xxv., **3**, 1932, p. 741.) The Federal pink bollworm quarantine regulations have been amended to authorize the use of a new form of roller equipment for the compression of cotton lint or linters as one of the conditions of certification under those regulations. The process was devised by commercial concerns for use at ginneries in order to reduce the bulk of cotton bales without incurring the expense involved in the present methods of high density compression. Experiments have shown that this equipment is apparently effective in the crushing of cotton seeds and pink bollworms which the bales may contain.

581. MALADIES DES VERS DU COTON (*Gelechia gossypiella* et *Prodenia litura.*). By S. Metalnikov and S. Metalnikov, Jnr. (*C.R. Acad. Agr. Fr.*, xviii., **6**, 1932, p. 203. Abstr. from *Rev. App. Ent.*, xx., Ser. A, Pt. 4, 1932, p. 245.) A study of *Platyedra* (*Gelechia*) *gossypiella*, Saund. (pink bollworm), and *Prodenia litura*, F., on cotton in Egypt showed that both are very susceptible to the attacks of various diseases. Larvæ of the former often become heavily infected during the autumn, and by December about 99 per cent. may be destroyed. From dead or dying larvæ the authors recovered two forms of *Bacterium gelechiæ* (Nos. 1 and 2), both of which produced death within twenty-four to forty-nine hours, and *B. rubrum*, which was also very virulent. From *P. litura*, of which the numbers were rapidly reduced by bacterial disease from the month of July onwards, twenty different micro-organisms were recovered, all of which, except *B. prodeniæ*, which was the only one proved to be virulent, were asporogenous. The four named forms of *Bacterium* which are readily cultured are briefly described. All these diseases appear only after the greatest damage has already been done by the larvæ, and it is suggested that if they could be propagated early in the season they would prove of great value in checking, if not eliminating, injury by the pests in question. *Earias insulana*, Boisd., which frequently is also a serious pest, was very scarce while these studies were being made.

582. HOLLYHOCK AS A TRAP CROP FOR BOLLWORMS OF COTTON. By L. Umrao Bahadur. (*Seasonal Notes*, Punjab Agr. Dpt., ix., **1**, 1932, p. 31.) This trap-

crop has been tried at the Military Farm at Okara, Montgomery, Punjab, for the last two seasons, and has proved very successful as a means of destroying the early broods of spotted bollworms.

583. STUDIES ON THE BIOLOGY AND CONTROL OF THE CORN-SEED MAGGOT (*Chortophila cilicrura* Rond.) By V. N. Rekatch. (*Transcaucasian Cott. Res. Inst. Gandja, Azerbaijan, U.S.S.R.*, 1932, Issue 18.) The corn-seed maggot is injurious to cotton, legumes, and cereals. Control measures include trap pits, and poisoned cotton-seed meal sprinkled over the field just before sowing.

584. THE GREASY CUTWORM (*Agrotis ypsilon* Rott.) IN EGYPT. By I. Eff. Bishara. (*Bull. No.* 114, Tech. and Sci. Serv. Min. of Agr., Egypt, 1932.) Deals with the subject as follows: General status; description and habits; occurrence as a pest abroad and in Egypt; relation to environment in the field; relation between temperature and development; evidence as to succession of broods in Egypt; direct evidence of the migration of *Agrotis ypsilon*; control of, by parasites, bait traps, hand picking, flooding, poison baits, and clean cultivation methods. The bulletin is well furnished with illustrations and diagrams.

585. NOTES ON TWO LOCUSTS OF MINOR ECONOMIC IMPORTANCE IN THE SUDAN. By H. B. Johnston. (*Bull. Ent. Res.*, xxiii., 1, 1932, p. 49. Abstr. from *Rev. App. Ent.*, xx., Ser. A, 6, 1932, p. 334.) *Anacridium mœstum*, Serv. (tree locust), and *Cyrtacanthacris tatarica*, L. (brown-spotted locust), two species normally having solitary habits, but liable under certain conditions to give rise to hoppers of a swarming type, and both potential pests, have been studied in the Sudan.

C. tatarica is said to occur in most parts of Africa and in India, where it occasionally becomes a pest of cotton, but appears to be absent from Egypt. Observations made chiefly in the irrigated cotton-growing district adjacent to the Blue Nile show that breeding may continue throughout the year, though at a very reduced rate in winter; in other areas reproduction is confined to the wet season. Continuous flight of the adults has never been observed, and migration probably never occurs, but the constant occurrence of *C. tatarica* on cotton shows that it is capable of passing to cultivated areas from its natural habitat among *Acacia* scrub, and then increasing in numbers until it can destroy the crop.

586. THE QUESTION OF THE MIGRATORY LOCUST CONTROL. By L. Z. Zakharov. (In Russian.) (*Plant Prot.*, viii., 3, 1931, p. 257. Abstr. from *Rev. App. Ent.*, xx., Ser. A, Pt. 5, 1932, p. 261.) For a long time it has been recognized that final success in the control of *Locusta migratoria* L., in the Northern Caucasus cannot be attained until work is concentrated on the permanent breeding grounds. So far, however, no real advance has been made in this direction, and throughout the last five years the infested area has remained very large. This is mainly due to the fact that the breeding grounds still remain unstudied, and the causes of locust multiplication in them unknown. It is suggested that fluctuations in the level of rivers may be responsible for outbreaks, but exact data are lacking. Defects in the existing control organization and technique are also held responsible for the incomplete success of control work.

587. TECHNICAL METHODS AND ORGANIZATION OF THE CONTROL OF THE MIGRATORY OR ASIATIC LOCUST (*Locusta migratoria* L.) By P. M. Rafes. (In Russian.) (*Bull. N. Caucas. Reg. Sect. Govt. All-Union Soc. Cont. Agric. For. Pests*, Ser. A, 4, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, Pt. 4, 1932, p. 196.) Detailed technical instructions are given for the application of the usual control measures and for dusting by aeroplanes. The latter method should be adopted only when the infested area is sufficiently large, since it is not economical if many small

areas have to be treated. One aeroplane can dust over 12,000 acres during a single campaign, from 1½ to 4 lb. of calcium arsenate or 2 to 3½ lb. of sodium arsenite being sufficient for about an acre.

588. THE OCCURRENCE OF THE MIGRATORY LOCUST (*Locusta migratoria migratorioides*) IN THE GOLD COAST AND ITS DEPENDENCIES DURING 1930. By G. S. Cotterell. (*Bull. Dpt. Agr. Gold Coast*, 23, 1931, p. 255. Abstr. from *Rev. App. Ent.*, xx., Ser. A, Pt. 4, 1932, p. 208.) Deals with the various swarms that invaded the country and the damage caused to crops. Of the various methods of control advocated, a poison bait consisting of 4 oz. sodium arsenite and 25 lb. dried horse dung or chopped grasses was found to be the most effective, as total extermination of hoppers can be obtained from it. It cannot, however, be used in all localities.

The bionomics of this locust are briefly discussed. The life-history is variable, being chiefly influenced by temperature. The incubation period ranges from ten to fifteen days, and the larval period from forty to sixty days. It is suggested that permanent breeding grounds from which the present swarming phase arose are in the vicinity of the River Niger in Senegal, or in the swamp district in the eastern corner of the Haute Volta, just north of Dahomey. To cope with future invasions, it is essential for these breeding grounds to be located and the conditions necessary for the change to the swarming phase to be studied thoroughly.

589. ON EXPERIMENTS IN THE USE OF POISON DUSTS AGAINST ADULT *Locusta migratorioides*, RCH. AND FRM., IN THE SUDAN. By H. H. King and B. A. Ruttledge. (*Bull. Ent. Res.*, xxiii., **1**, 1932, p. 65. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **6**, 1932, p. 336.) Swarms of *Locusta migratorioides* appeared in the Sudan in 1930 and 1931, after an interval of forty years. The swarms of adults move in dense, massed formation and at no great height from the ground, which should make them vulnerable to poison dust. Control is suggested by dusting flying swarms from aeroplanes with sodium arsenite powdered to pass through a standard 240 sieve. Experiments showed that locusts that had fluttered in the dust cloud for approximately twenty seconds showed signs of discomfort within half-an-hour, and died after about two hours. Paris green and arsenious oxide had a much slower action when tested in the same way.

590. CONTROL OF THE MOROCCAN LOCUST IN AZERBAIJAN BY THE AVIO METHOD. By V. Suitin. (In Russian.) (Mater. 1st All-Union Avio-Chem. Conf. Moscow, 1930. Abstr. in *Rev. App. Ent.*, xx., Ser. A, **7**, 1932, p. 391.)

591. COTTON PLANT INFESTED BY RED SPIDERS: PHYSIOLOGY. By Blagoveshchenskii *et al.* (*Chem. Abs.*, **26**, 1932, p. 1960. Abstr. from *Summ. of Curr. Lit.*, xii., **12**, 1932, p. 352.) Infestations by red spiders bring about (1) a disturbance in stomata causing them to open wider; (2) a lower diffusion of gases and water vapour through the stomata; (3) a lowering of the water content of leaves; (4) a depression in photosynthesis; (5) a speeding up of the process of respiration; (6) a decrease of chlorophyll in the leaves; (7) a lowering of the carbohydrate content of the leaves and a still greater lowering of nitrogen; (8) a decrease in amino nitrogen; (9) an increase of magnesium in the leaves.

592. BIOLOGY AND SIGNIFICANCE OF THE RED SPIDER, *Eutrombidium debilipes* LEONARD, AS A PARASITE OF THE MIGRATORY LOCUST. By A. A. Popova. (*Bull. of Plant. Prot.*, Ent. Series No. 3, Lenin Acad. of Agr. Sci. in U.S.S.R. Inst. for Plant Prot., 1932.) (In Russian.) The long and interesting summary in English describes the research work on the red spider carried out in Daghestan in the summer periods of 1927 and 1928.

593. A NEW METHOD OF QUANTITATIVE-STATISTICAL ANALYSIS OF RED SPIDER INFESTATION (*Epitetranychus althææ*). By A. M. Il'inskii. (In Russian with summary in English.) (*Plant Prot.*, viii., **3**, 1931, p. 299. Abstr. from *Rev. App. Ent.*, xx., Ser. A, Pt. 5, 1932, p. 263.) In the course of observations in Transcaucasia on *Tetranychus telarius* L. (*Epitetranychus althææ* v. Hanst.) on cotton, the degree of infestation was estimated by samples obtained by gently pressing infested leaves against a sheet of smooth paper coated with an adhesive. The mites remained fixed by their backs to the paper, on the dark surface of which they were clearly perceptible, and as the living individuals continued to move their legs they were readily distinguished from dead ones. Usually the mites remained alive for several hours. Gum arabic appeared to be the best adhesive, as, though it dried out in fifteen to thirty minutes, the mites were not killed, whereas glues of the type of " tanglefoot " were toxic to them. The eggs did not stick to the paper and had to be counted on the leaves. As cotton leaves have very thick veins, some of the mites may not be reached by the adhesive if the coating is too thin.

594. CONTROL OF THE RED SPIDER MITE (" CHOR ") AND OF THE LARVÆ OF THE MALARIA MOSQUITO IN ARMENIA. By I. V. Sazonov and E. S. Stregulina. (In Russian.) (Mater. 1st All-Union Avio-Chem. Conf., Moscow, 1930. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **7**, 1932, p. 391.) Control measures by dusting with flowers of sulphur from an aeroplane are described.

595. BORDEAUX MIXTURE: COMPOSITION. By H. Martin. (*Ann. Appl. Biol.*, **19**, 1932, p. 98. Abstr. in *Summ. of Curr. Lit.*, xii., **9**, 1932, p. 278.)

596. THE MORPHOLOGY AND CYTOLOGY OF *Bacterium Malvacearum* E.F.S. II.: REPRODUCTION AND CELL-FUSION. By R. H. Stoughton. (Reprinted from *Proc. of Roy. Soc.*, B, vol. iii., 1932.) Using a technique described in a previous paper, new morphological forms have been observed in *Bacterium malvacearum*. The production of coccoid bodies, their liberation, and subsequent germination to form apparently normal rods, are described. The formation of densely staining spherical bodies, apparently arising from the point of fusion of two cells, is described. These bodies are apparently liberated by the degeneration of the parent cell.

[*Cf.* Abstr. **249**, Vol. VII., p. 159, and Abstr. **494** of present number.]

597. A LIST OF PLANT DISEASES OCCURRING IN SOUTHERN RHODESIA. By J. C. F. Hopkins. (*Rhod. Agr. Jour.*, xxix., **6**, 1932, p. 462.) The following are given for cotton: Leaf spot, Seedling blight, Sooty mould.

598. A PRELIMINARY REPORT ON THE STUDIES OF CERTAIN DISEASES OF COTTON. By S. C. Teng. (*Contrib. Biol. Lab. Sci. Soc. of China*, Bot. Ser. VI., **10**, 1931, p. 117. Abstr. from *Rev. App. Mycol.*, xi., **5**, 1932, p. 298.) Cyrtosis or club leaf of cotton was originally named, described, and figured by O. F. Cook, but S. C. Wang was the first to demonstrate the association of the leaf-hopper (*Chlorita biguttula*) with this disease. An experiment to ascertain whether cyrtosis would pass from one part of a cotton plant enclosed in a glass chimney, in which leaf hoppers were placed, to another, gave negative results, no cyrtosis developing on any part outside the chimney. Attempts to produce the condition in insect-proof cages by various mechanical methods were also unsuccessful. Since feeding for short periods failed to produce cyrtosis, and since the severity of the disease increased more or less directly with the number of leaf hoppers feeding on the plant, it seems possible that the disorder is due merely to direct injury by the insect. Bengal cotton (*Gossypium arboreum*) was shown by a test to be resistant to cyrtosis, while eight hairy varieties of Chinese cotton (*G.Nanking*) were more or less susceptible. Hairiness alone, therefore, evidently does not confer resistance to cyrtosis, which is probably associated with some inherent chemical character in the Bengal variety. All the fifty cotton varieties tested for their reaction to "sore shin" (*Rhizoctonia*)—viz., one of *G. hirsutum*, two of *G. arboreum*, and forty-seven of *G. Nanking*—proved equally susceptible to the disease. Thirteen other species of plants belonging to eight families were also found to be susceptible. Moderately good control was given by scattering naphthalene along the rows at the rate of 30 lb. per acre at planting time, followed by another 30 lb. a week after germination as well as by Ceresan and Du Bay organic mercury dust No. 738 at the rate of 6 lb. per acre.

599. CONTRIBUTO ALLO STUDIO DELLA PATOLOGIA VEGETALE IN SOMALIA. By V. Rossi. (*Agricolt. Colon.*, xxv., **11**, 1931. Abstr. from *Rev. App. Mycol.*, xi., **7**, 1932, p. 475.) In Italian Somaliland cotton grown from Egyptian seed showed a wrinkling of the leaves with ulcerations on the veins and stems, while the leaf stalks were cracked and scaled, similar lesions being present in places on the leaf blades, but unrelated to the wrinkling. The nectaries at the base of the main veins were attacked on the under surface by sooty moulds. Other leaves of the same cotton were infected by *Uredo gossypii* (*Cerotelium desmium*).

600. A DISEASE OF YOUNG COTTON PLANTS CAUSED BY *Sclerotium rolfsii*. By W. N. Ezekiel and J. J. Taubenhaus. (*Phytopath.*, xxi., **12**, 1931, p. 1191. Abstr. from *Rev. App. Mycol.*, xi , Pt. 5, 1932, p. 298.) Cotton seedlings growing in fine sandy loam soil at College Station, Texas, were attacked in July, 1929, by *Sclerotium rolfsii*, which girdled the stem bases and caused the rapid wilting and death of the plants. The infected areas first developed a water-soaked appearance and then became constricted near soil level; sometimes the cortex split along the diseased portions. The fungus passed from plant to plant on or through the soil, producing the typical mycelium and sclerotia. Inoculation experiments with *S. rolfsii* from cotton and carrots gave positive results on cotton seedlings, but tests with the same organism from carrot and guar (*Cyamopsis tetragonoloba*) on other plants were unsuccessful, and the fungus is thought to attack mature plants only rarely. Fewer plants were infected by *S. rolfsii* on plots treated with the organic mercury compounds, K-I-X, PMA, semesan, No. 664, and Bayer dust against *Phymatotrichum omnivorum*, than on control plots.

601. DIE BEKÄMPFUNG DER "CHUPADERA"-KRANKHEIT DER BAUMWOLLE IN PERU DURCH BEIZUNG MIT CERESAN. By J. Wille. (*Nachricht. über Schädlingsbekämpf.*, vii., **1**, 1932. Abstr. from *Rev. App. Mycol.*, xi., **7**, 1932, p. 455.) Very good control of the "chupadera" (sore shin) disease of cotton was obtained over an area of 6 hectares near Callao, Peru, by dusting the seed with Ceresan at the rate of 600 gm. per 70 kg. of seed. The incidence of infection was reduced from 80 to 30 per cent.

602. WILTED COTTON PLANTS: LEAF TEMPERATURES. By W. N. Ezekiel and J. J. Taubenhaus. (*Sci.*, **75**, 1932, p. 391. Abstr. from *Summ. of Curr. Lit.*, xii., **11**, 1932, p. 312.) Measurements made with mercury thermometers and with thermocouples showed that leaves from plants wilted from *Phymatotrichum* root rot were as much as 6·5° F. warmer than air temperature, whilst leaves from normal plants were usually cooler than air temperature. In July and in September, 1930, leaves from root-rot infected cotton plants averaged about 3° F. warmer than leaves from normal plants.

603. COTTON WILT STUDIES: IV. EFFECT OF FERTILIZERS ON COTTON WILT. By V. H. Young *et al.* (*Bull. No.* 272, Univ. of Arkansas, 1932.) High potash applications alone, and fairly high potash applications in combination with nitrogen- and phosphorus-containing salts, have given definite control of cotton wilt at points in central, eastern, and north-eastern Arkansas. High nitrate applications, applications containing nitrogen and phosphorus only, and applications of cottonseed meal alone, were inefficient in cotton wilt control. The control of cotton wilt through the use of potash-containing fertilizers seemed in nearly all cases to be correlated with or coincident to the control of "rust," stimulation of vegetative growth, and increased yields of seed cotton. Recent work published by Ware, Young, and Janssen (1931) indicates that there are excellent long, medium, and short staple cottons which are either highly resistant or somewhat resistant to cotton wilt, some of which are suitable for all localities where the disease is a problem in Arkansas. It may be concluded, therefore, that on those sandy alluvial soils where cotton wilt and rust are often found together in a severe form, a combination of a suitable wilt-resistant variety of cotton and the judicious use of a fertilizer containing potash will prove the best possible solution of the problem now available. It should be emphasized that root-knot infested soils must be freed of the root-knot nematode by proper rotations before the best results can be expected from any type of control for cotton wilt.

(*Cf.* Abstr. **401**, Vol. IX., 1932, and **520** of this number.]

604. COTTON ROOTS: INJURY BY ACID. By J. J. Taubenhaus and W. N. Ezekiel. (*Chem. Abs.*, **26**, 1932, p. 1377. Abstr. from *Summ. of Curr. Lit.*, xii., **10**, 1932, p. 286.) Where extreme soil acidities resulted from excessive application of sulphur, injury to cotton roots was evidenced by a characteristic enlargement and cracking, often resulting in death of the plants.

605. MOULD FUNGI: GROWTH AND STEROL CONTENT. By L. M. Pruess *et al.* (*Biochem. Z.*, **246**, 1932, p. 401. Abstr. from *Summ. of Curr. Lit.*, xii., **11**, 1932, p. 325.) The growth and sterol contents of thirty *Aspergillus*, twenty *Penicillium*, and fifteen other types of mould fungi have been studied. The fungi were grown on synthetic and on organic nutrient media to which 10 per cent. glucose was added. The sterol contents of ten kinds of higher fungi were also determined. The weight of dry mycelium varied between 0·23 and 5·03 gm. per 100 c.c. of liquid. Glucose estimations in the inorganic medium showed that approximately 25 to 35 per cent. of the sugar used was accounted for by the increase in the weight of the mycelia. The sterol contents varied between 0·17 and 1·70 per cent. of the dry weight of the fungi. Both the sterol content and the weight of the *Aspergillus* fungi were doubled by the addition of calcium carbonate to the inorganic medium. This increase was due to the decrease in hydrogen ion concentration, not to the presence of calcium ions.

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606. THE CHEMICAL MICROSCOPY OF PLANTS. By O. Tunmann, rev. by L. Rosenthaler. (*Pflanzenmikrochemie*, Berlin: Borntraeger Bros., 1931. Abstr. in *Exp. Sta. Rec.*, 66, **7**, 1932, p. 605.)

607. A NOTE ON THE USE OF LACTIC ACID IN PLANT HISTOLOGY. By T. R. Seshadri and G. S. Aiyangar. (*Ind. Jour. of Agr. Sci.*, ii., Pt. 1, 1932, p. 51.) Deals briefly with the use of lactic acid as a reagent for clearing microscopical preparations of plant tissues.

608. CORRELATION OF CERTAIN LINT CHARACTERS IN COTTON AND THEIR PRACTICAL APPLICATION. By G. N. Stroman. (*J. of Agr. Res.*, 44, **6**, 1932, p. 523.) Data on nine sister families showing the correlation relationship between lint percentage, lint index, boll weight, and length of lint, are reported. The families studied sprang from a hybrid plant, which was probably an Upland-Egyptian cross. The mean standard deviation and range are given for all four characters for each of the nine families. Simple and partial correlation coefficients are shown between all characters for each family, and multiple correlations, using each character as the primary, are given for all families. These data are discussed both from the standpoint of genetics and from that of the practical breeder. Lint percentage and length of lint are considered especially in relation to the other characters, and their practical importance is pointed out.

609. THE GERMINATION OF COTTONSEED AT LOW TEMPERATURES. By C. A. Ludwig. (*J. of Agr. Res.*, 44, 4, 1932, p. 367.) The minimum temperature for the germination of cottonseed is approximately 12° C. The increase in activity up to 15° is rapid. Seeds that do not germinate at a given low temperature will often remain viable as long as two months or more under the unfavourable conditions. Of all the varieties studied Pima and two varieties of *Gossypium Nanking* exhibit the most rapid and most complete germination at low temperature. A strain of Cleveland used repeatedly ranks well toward the foot. Most of the Upland varieties studied are intermediate, but owing to conflicting evidence it is impossible to rank them among themselves. There are individual variations in the ability of cottonseed to germinate in the cold, which if hereditary and correlated with seedling hardiness, can be used in selecting for this latter character. There is some indication that the rate and percentage of germination in the cold increase with the age of the seed, at least for a year or two.

610. COTTON HAIR: DEVELOPMENT. By A. P. Sakostschikoff and G. A. Korshenioksky. (*Faserforschung*, 9, 1932, p. 249. Abstr. from *Summ. of Curr. Lit.*, xii., 9, 1932, p. 274.) The authors have studied the structure of the cotton hair at various stages of development by methods involving microscopic observations, micro-chemical reactions, and swelling tests. The results of this work show that the development of the hair in the course of the first fifteen to sixteen days after flowering is characterized by the development of the hair cuticle, and that cellulose deposition does not occur in this period. Cellulose first appears on the sixteenth day after flowering, when the second period of development—*i.e.*, the formation of the cell wall—begins. The cellulose is deposited in the form of a network in the space between the cuticle and the continuous concentric layers (growth rings) which are formed later. These concentric layers have a well-marked spiral structure. The network appears to be directly connected with the structure elements of the cell wall found in microscopic observations and in the reaction with concentrated sulphuric acid. A regular increase in the number of growth rings with age of the hair is not observed. A decrease in the protein content occurs with increasing age of the hair. Tanning materials are not found at any stage, and no evidence for the presence of starch has been obtained. The cuticle differs in structure from the cellulose of the hair. After long hydrolysis with zinc chloride the cuticle gives products which, like the products of hydrolysis of cellulose, give a blue colour with iodine. No fibrillar or spiral structure is observed in the cuticle under the microscope. The results of application of the Calvert-Harland method to determinations of the "true" diameter of the hair show that this diameter remains constant during the development of the hair. Further work is necessary before a complete theory of the structure of the cotton hair can be formulated.

611. THE EXTENT OF VICINISM IN COTTON AT CLEMSON COLLEGE. By G. H. Collings and R. W. Wallace. (*J. Amer. Soc. Agron.*, 23, 6, 1931. Abstr. from *Exp. Sta. Rec.*, 66, 6, 1932, p. 529.) Seed cotton was picked from rows of green-leaf varieties at about 10, 20, 30, 40, 50, 100, 150, and 200 feet in several directions from a field of red-leaf cotton near the South Carolina Experiment Station. Germination tests of the seed showed only sixteen seedlings, out of 2,075 seeds germinating, to be hybrids. The red colouring matter was present in the tissue and was apparent as soon as the seed germinated, obviating field or greenhouse

cultures. The prevailing winds during the flowering season evidently did not markedly influence pollination, the cross-fertilization which occurred probably being due almost entirely to insects. No vicinists were found farther than 40 feet from the red-leaf cotton.

612. A Preliminary Note on the Contabescence of Anthers in Cotton. By R. Sankaran. (*Agr. and Livestock in India*, 11, 3, 1932, p. 297.) The percentage of anthers per flower in the abortive condition known as "contabescence" is found to exhibit a periodic seasonal fluctuation. The early-formed flowers are prone to contain a much higher percentage than the later-formed ones. It is suggested that this diminution in contabescence may be due to the higher temperatures prevailing then, and the senescence of plants at the later period.

613. Pollen Antagonism in Cotton. By T. H. Kearney. (*J. of Agr. Res.*, 44, 3, 1932, p. 191.) *Summary.*—Emasculated flowers of Pima and of Upland cotton, pollinated with approximately equal quantities of pollen of both types, have shown a marked degree of selective fertilization; the resulting populations have contained a much higher percentage of homozygous than of heterozygous plants. Applications of either pollen separately showed that these cottons are highly compatible, as fertilization of the flowers of either Pima or Upland cotton has been effected almost or quite as readily by the unlike as by the like pollen. So far as could be determined by observation and by tests in media not suitable for normal germination, there were no differences in the viability of the two pollens that could account for the selective action observed. No evidence was obtained of selective survival at any stage after formation of the zygote that would explain the preponderance of homozygous plants in the populations. Selective survival undoubtedly occurred in some of the experiments, owing to infestation of the soil with nematodes which are known to cause much greater mortality among the Pima plants than among the Pima×Upland F_1 plants. In all such cases survival of the heterozygotes was favoured, so this factor tended to nullify rather than to accentuate the appearance of selective fertilization. Comparisons of the degrees of fertilization effected when the styles were excised at shorter and at longer intervals after pollination, and of populations grown from seeds in the upper and in the lower half of the boll, gave no consistent evidence of a differential rate of growth of the tubes of the like and of the unlike pollen. This factor, apparently responsible for selective fertilization as observed in Zea, Œnothera, and other plants, does not account for the situation met with in Gossypium. The only explanation that seems tenable is that the presence of the like pollen induces a reaction in the stigmatic tissues of such a nature as to render them less suitable for the development of the unlike pollen. Apparently the effect is extremely local or else individual pollen grains differ greatly in their ability to withstand the unfavourable condition, since in all the experiments with pollen mixtures some of the ovules were fertilized by the unlike pollen. Evidence of the localization of the reaction was afforded by an experiment in which the like and unlike pollens were (1) deposited separately on opposite sides of the same stigmas; (2) mixed, but not intimately, and applied to the whole surface of the stigma; and (3) mixed intimately and applied to the whole surface. The percentage of homozygous plants was least in the population from treatment (1), and greatest in the population from treatment (3). Experiments in which the viability of the like pollen was destroyed by maceration before it was applied to the stigmas gave conflicting results, but the weight of the evidence favours the conclusion that the inhibiting effect upon the unlike pollen takes place only when the like pollen is intact and viable. Therefore, penetration of the stigmas by the tubes of the like pollen seems requisite to the setting up of the reaction. This supports the assumption that the inhibiting substance is produced in the

stigmatic or stylar tissue in response to a stimulus supplied by the tubes of the like pollen. If the hypothesis is well founded, the phenomenon observed in cotton is of a chemical or physiological nature. The term "pollen antagonism" is suggested in order to distinguish it from the selective fertilization observed in other plants and attributed to differential growth rate of the pollen tubes conditioned by specific genes determining the rates of growth. Little or no selective fertilization was observed between more nearly related forms, these being two families of Pima cotton differing only in a simple Mendelian character. The evidence is too scanty, however, to warrant the conclusion that the degree of pollen antagonism in cotton is definitely related to the degree of consanguinity, as Jones found to be the case with selective fertilization in maize.

614. A CHIMERA IN COTTON. By P. Gopalaratnam. (*Madras Agr. J.*, **20**, 1932, p. 151. From *Plant Breeding Abstracts*, 11, **4**, 1932, p. 161.) A variegated plant is described. Seeds from the mottled section gave some green and some cream seedlings; the latter died immediately.

615. COTTON STALK CELLULOSE: PRODUCTION. (*Text. World*, **81**, 1932, p. 945. Abstr. from *J. of Text. Inst.*, xxiii., **5**, 1932, A244.) A note on the cultivation of the cotton plant as a source of cellulose. The plant is harvested like hay and all but the roots utilized in the subsequent chemical processes. The maximum yield of cellulose is reached at the end of twenty-three weeks' growth, and there is a prospect of obtaining 5,000 lb. of mixed stalk and lint per acre.

616. THE COTTONS OF MEXICO, GUATEMALA, AND COLOMBIA. By F. M. Mauer. (Supplement to the *Suppl.* 47, *Bull. Appl. Bot. Genet. and Plant Breeding, U.S.S.R.*, 1930, pp. 425-464.) (Review.) In 1925 the Institute of Applied Botany (Leningrad) sent an expedition to Central America in order to collect, among other economic plants, material from the rich and varied assemblage of cottons known to be present in this region. The material was given over to the Turkestan Plant Breeding Station for the further work of botanical and agronomic study, involving a large number of crosses to establish the relationships of the various types.

The report is said to be a preliminary communication, the object of which is to give a description of the material collected by the expedition. A translation of the most important sections of the report has been made from the original Russian by the Imperial Bureau of Plant Genetics, and it is this translation that the writer has employed in putting together these notes.

A large number of cottons, many of them new and certainly economically valuable, are described from Mexico, Guatemala, and Colombia. These have been found to differ both physiologically and morphologically from the ordinary cultivated Uplands and Sea Islands. The author stresses their adaptability to abundant moisture conditions or to drought, and points out that certain hill forms are probably resistant to low temperatures. He says: "The further study of them, together with many other tropical and sub-tropical forms, will undoubtedly disclose many extraordinarily valuable physiological hereditary characters which will be widely used in creating new forms."

The cottons found fell into two main groups, which are regarded as belonging to two Linnæan species.

1. The South American group (*G. barbadense* L.).
2. The Central American group (*G. hirsutum* L.).

The former group includes the perennial Kidney cottons and the Peruvian Marie Galante types, as well as Sea Island and Egyptian, while the latter group includes the large assemblage of Bourbon cottons, Egyptian Hindi, and the Uplands. While we may accept the South American group as a single species, it is not so clear that the Central American group of Bourbons, which extends from Florida to Brazil, is to be merged in Upland (*G. hirsutum* L.).

The reviewer has considerable experience of the genetics of the Bourbon group, and has expressed the view that this group constitutes a separate species (*G. purpurascens* Poir). We may agree with the Russian workers that the Bourbon group is closely allied genetically to Upland, since crosses between the two are fully fertile in both F_1 and F_2. Our reasons for retaining the specific name *G. purpurascens* are mostly based on ecological considerations, though there is evidence that a number of factors present in the Bourbon group are absent from Upland.

Thus the factor R_2 for red plant body of Bourbon has proved to be identical with the red factor of Peruvian, while the red factor of Upland is a duplicate factor R_1. Similarly there are differences in the constitution of the two groups in regard to factors for chlorophyll deficiency. Morphologically the Bourbon group differs also from the Upland in a good many well-marked characters.

Perhaps the most interesting physiological features of the tropical cottons observed are those connected with photoperiodism. As is well known through the researches of Allard and Garner, certain plants require a long day to initiate a reproductive phase, others a short day. The reviewer found some years ago that the perennial cottons of the tropics refused to flower in a greenhouse in England, and the reason for this is now apparent through observations made in Turkestan. The author states:

"From the investigation of the materials it may be seen that the forms of the tropical belt show a marked adaptation to a short day, which is sufficiently indicative of the fact that they are endemic for the Tropics. Only an inconsiderable part of the tropical forms is characterized by a long photoperiod. As these forms differ sharply by their morphological characters from the bulk of cottons, it is thought that they have been introduced into these regions in the very last historical period from more northern latitudes, chiefly from the United States and from West India.

"The study of the material collected was greatly complicated, not only by its vastnesses, but also by the fact that it consists chiefly of tropical forms adapted to a short day. However, by means of an artificially shortened day (first used on a small scale by G. S. Zaitzev) this difficulty could be overcome.

"Under the conditions of the long day connected with our latitudes of Tashkent, an entirely abnormal behaviour of the tropical cotton plants can be observed. The reproductive phase is either much delayed or does not set in at all. The plant grows luxuriantly, reaching a great height, the limbs or vegetative branches are very numerous, while the fruiting branches sometimes do not appear at all before the frosts set in. All vegetative parts, especially leaves and stipules, reach great dimensions and are abnormally strongly divided. The rankly growing leaf blade shows a vesicular surface, thus the whole aspect of the plant sharply differs from a normal one. To study the reproductive organs, the flowers, bolls, seeds and fibre, becomes impossible.

"When the same forms are grown under the conditions of a short (twelve hours) day, the behaviour of the plant entirely changes; the reproductive phase sets in considerably earlier, the vegetative development of the plant is much less, all vegetative organs being reduced in number and in dimensions. The height of the plant is less; the monopodial branches decrease in number and dimensions, while the fruiting branches are formed early and at a low height."

By employing a shortened day the Turkestan workers have been able to induce the perennial cottons to flower in the sub-tropics and thereby to effect crosses with Upland varieties. The object of crossing is to render the great genetic diversity of the Central American cottons available for the improvement of Upland and Egyptian cottons. The author states:

"The varietal diversity and botanical composition of the Central American cottons is of profound interest for several reasons.

"Firstly, here is a country with a cotton cultivation of the greatest antiquity, existing long before the discovery of America by Europeans. Moreover, in these regions we have the most ancient areas of the species *G. hirsutum* L. and *G. barbadense* L.

"These countries furnished the world with all that diversity of sorts of Upland and Sea Island on which the cotton industry of the majority of countries of the Old and New Worlds is based. The varietal diversity of the ancient cultivations of the New World is far from exhausted, new sorts of Mexican origin are constantly being found, after which they receive general recognition and wide application—*e.g.*, Acala, Durango, etc.

"For this reason it is essential to give serious attention to the study of the varietal wealth accumulated in these countries during a thousand years of cotton cultivation and breeding."

With this point of view every geneticist and cotton breeder will be in entire sympathy, and it is one which the present reviewer has frequently expressed. The Russian botanists are the first to make a systematic exploration of the possibilities of the cottons of Central America. The cotton-growing industry will undoubtedly reap a rich reward.—*S. C. Harland.*

617. CHROMOSOMES AND PLANT-BREEDING. By C. D. Darlington, Ph.D., D.Sc., with a foreword by Sir Daniel Hall, K.C.B., F.R.S. (xiv + 112 pp., with twenty-five text figures. Macmillan and Co., Ltd., London, 1932. Price 7s. 6d. net.) (Review.) In an admirable foreword which adds much to the value of the book, Sir Daniel Hall says that "It has been Dr. Darlington's purpose in the present book to set out the recent developments in the study of the chromosomes and to point out their bearing on the practice of plant breeding." As the chief cytologist at the John Innes Horticultural Institution, Merton, Dr. Darlington is eminently fitted to describe the recent rapid advances that have been made in the important studies of the chromosomes. During the last five years his own original contributions to these studies have been considerable and brilliant, as his recent large text-book on cytology clearly shows. The present small book on chromosomes is of a more popular and practical nature and is based on a series of articles that appeared in the *Gardeners' Chronicle* in 1931. There are seventeen short chapters dealing with heredity, the cell and its nucleus, mitosis (cell-division), clones and apomixis (virgin birth), fertilization and haploidy, reduction or meiosis, Mendelism, qualities of chromosomes, variation, tetraploids with and without hybridization, polyploid species, breeding with polyploids, crossing polyploid species, sterility in polyploids, triploids, and lastly secondary polyploids, surely a feast of chromosomes for the plant breeder.

At this time of day it is hardly necessary to emphasize the importance of a knowledge of the chromosomes to the practical cotton grower and breeder. It is now generally recognized that the fundamental basis of a good crop of good cotton is the production and selection of suitable varieties for different districts, and that the suitability of a variety depends entirely on the particular complex of genes and chromosomes that are carried in the cells of that variety. Dr. Darlington's book will help growers to understand the mystery of how all this comes to be. He shows how every seedling plant arises from the coming together of a pollen nucleus of the father and an egg-nucleus of the mother, each carrying a set of chromosomes and genes peculiar to itself, which when combined by fusion, determine the destiny of the plant, what it will be, what it will do, and how it will react to the conditions of life in its growth from the seed to the seeds. Without the chromosomes and their genes there would be no heredity and no handing on of characters from generation to generation, nor indeed would there be any growth at all, since this depends on the doubling of the cells by the chromosomes splitting in two and making new cells. A striking proof of the importance of the chromosomes is given in Chapter VIII., where Darlington points out that in *Datura* and in Tomato it is possible to pick out the plants carrying different extra chromosomes by simply looking at them and their external characters without a microscopical examination of their chromosomes. Darlington shows how the presence of extra chromosomes over and above the normal sets in many cases causes loss of vigour and loss of fertility. He cites the case of the triploid Blenheim Orange Apple, which, although itself a good cropper and vigorous grower, produces seedlings with odd chromosomes which are consequently infertile and of weakly growth, so that the old rule of breeding from the best does not always hold good.

The important question of polyploidy is dealt with rather fully, and Dr. Darlington gives an interesting account of the fourteen new species and three new genera that have appeared in experimental cultures during the last decade. These include the Ægilops-Wheat (*Aegilotricum*), the Wheat Rye (*Triticale*), the Radish-Cabbage (*Raphano-brassica*), and the Turnip-Swede hybrids which have doubled their chromosome sets and become fertile new species or genera. He wisely advises all plant-breeders who have raised sterile hybrids to look out for the odd seed which will give them a new giant fertile polyploid race or species. In Chapter XII. Dr. Darlington gives a brief list of representative wild and cultivated diploid and polyploid species and subspecies of several genera, and the list includes two diploid cottons, *Gossypium arboreum* and *G. indicum* (Indian and Chinese cotton), and two polyploid cottons, *G. barbadense* and *G. hirsutum* (American and Sea Island Cotton). Darlington grades the latter as tetraploids, although the basic number of chromosomes, thirteen, suggests secondary polyploidy. It is unfortunate for the Cotton Industry that so little is known about the chromosomes of the cotton species and varieties; so far only the chromosome numbers have been counted, and little attempt has been made to investigate either the morphology or the behaviour of the chromosomes in the different cultivated races. Recent research and Darlington's book show the vital necessity of such research.

In Chapter XIV. Dr. Darlington suggests that rapid improvement can be made by crossing polyploid species with the same chromosome number with one another. He thinks that they are more likely to be fertile than diploid hybrids, and the result will not depend so much on chance, since polyploidy is there to start with. Judging by the numerous results already obtained in the hybridization of distinct tetraploid species of *Rosa*, Darlington's view is no doubt correct. The reviewer has found, however, a great deal of sterility in these hybrids, and losses of whole specific sets of chromosomes are a frequent occurrence, as well as other transmutations in the form of translocations by which means the specific sets have become considerably changed in their gene content, as in the *Pernetiana* Roses, which are derived from four distinct diploid species, but remain definitely tetraploid.

Chapter XV. deals with the advantages and disadvantages of triploids in plant breeding. Darlington shows that most triploids have arisen accidentally under cultivation by the crossing of an unreduced germ-cell with a normal reduced one, thus giving them an odd set of unbalanced chromosomes, which causes the plant to be highly sterile. On the average these triploids produce balanced chromosomes in their germ-cells, making them fertile, only once in over a hundred times. Many of the triploids are, however, of great value in cultivation, since they can be propagated by other means than seeds, as in the Japanese ornamental cherries, tulips, daffodils and roses. Most of the best varieties of garden hyacinths are triploids with larger bulbs and flowers, and many of the best apples, such as Bramley's Seedling, Blenheim Orange, Warner's King and Ribston Pippin, are also triploids. In conclusion Dr. Darlington shows how, in various ways, a study of the chromosomes helps the breeder in the selection of the parents for his matings, and his little book will be a welcome addition to the library of the practical plant breeder who wishes to keep himself abreast of the times in these rapid days when it is difficult even for the expert geneticist to keep in touch with the latest discoveries.

The book is well printed and produced, with excellent figures, and the price is moderate.—*C. C. Hurst.*

618. Cotton Improvement through Type Selection, with Special Reference to the Acala Variety. By O. F. Cook. (*Tech. Bull. U.S. Dept. Agr.*, 1932, No. 302. From *Plant Breeding Abstracts*, 11, 4, 1932, p. 197.) The author emphasizes the fact that while, in animal breeding, the main concern is with the individual, in plants that concern is with bulk. Commercialism is unlikely to produce adequate supplies of good seed in the cotton industry; it tends towards the introduction of too many varieties, while what is required is the maintenance of existing superior varieties. He concludes that seed improvement is essentially a community undertaking. The adaptability of a variety, defined as the retention of productivity under a wide range of conditions, becomes, thus, as important a character as uniformity, while selection should be a means of preventing deterioration rather than a means of improvement. Too frequently in the past selection has concentrated on novelty, and since diversity rather than uniformity seems to be inherent in all natural species, such selection has proved a blind road.

Four systems of selection are recognized; mass, individual, progeny, and type; a combination of the two latter is required for maintenance of uniformity with adaptability. Difficulty arises in the determination of type for selection, and the system of score cards has not given proved results. Fortunately variations are normally "symphanic" (occur, that is, in conjunction), and off forms can be identified by more than one character. Too severe a selection with limitation of the number of progeny rows is likely to eliminate the adaptability which has been shown to be a desirable and possible accompaniment of uniformity, and for full maintenance of type it is necessary to maintain groups of progenies in different regions covering the range of conditions for commercial growth.

Illustrations of the application of the methods of selection here advocated are given by somewhat detailed reference to Acala cotton, particularly in its reaction to response to varying environmental conditions and conditions of stress.

619. On International Co-operation of Selectionists in Tropical Countries. By O. Posthumus. (*Bull. Assoc. Internat. Sélectionneurs Plantes*, 4, 1931, p. 226. From *Plant Breeding Abstracts*, 11, 4, 1932, p. 172.) The international relations between plant breeders, stopped by the war, have been renewed in the tropics by a number of organizations concerned with the problems connected with tropical crops. These are independent of similar organizations in the temperate zones. The hope is expressed that the International Association of Plant Breeders may establish contact with these other associations, and so prove itself a truly international organization.

620. Zweiter Turkischer Pflanzenzuchterkongress vom 20-28 Februar, 1932. (The second Turkish Plant Breeding Congress, February, 1932.) By F. Christiansen-Weniger. (*Der Zuchter*, 4, 1932, p. 110. From *Plant Breeding Abstracts*, 11, 4, 1932, p. 172.) A brief account of the organization of the plant breeding work in Turkey.

621. Work of the Cyto-Anatomical Laboratory of N.I.KH.I. during the Growing Period of 1930. By P. Baranov. (*Bull. Sci. Res. Cott. Inst.*

Tashkent, **5**, 1930, p. 7. From *Plant Breeding Abstracts*, 11, **4**, 1932, p. 197.) One of the first studies was the full history of the cotton plant from germination to maturity. The first stage in this was the study of the chromosomal apparatus. Seven Old World species were found all to have twenty-six diploid chromosomes; these were *Gossypium Stocksii*, *G. arboreum*, *G. Nanking*, *G. obtusifolium*, *G. herbaceum*, *G. abissinicum*, and *G. intermedium*; whilst seven New World species had fifty-two: *G. punctatum*, *G. hirsutum*, *G. Palmeri*, *G. peruvianum*, *G. mexicanum*, *G. purpurascens*, and *G. barbadense*.

A detailed examination was made of the morphology of the chromosomes in the various species. Clear differences were evident, chromosomes with equal and unequal arms, divided and undivided arms, and with or without satellites, being observed, as well as differences in size of the respective arms and of the satellites. The karyotype for each species and its component varieties is now under investigation.

The microsporogenesis was studied in representatives of the twenty-six and fifty-two chromosome groups, the size of bud in which it was taking place was determined; for this the stages reached by all the buds on a whole sympodium were determined. The process of microsporogenesis is described for the variety Navrotskii of *G. hirsutum*.

A detailed study of the embryo sac development was also made, and the development is described for *G. herbaceum*. In many cases more than one embryo sac arose in one ovule, but only one of these finally developed. The whole development is extremely complicated. A detailed knowledge of the development of the female gametes is necessary for the study of the question of boll shedding and the production of artificial mutations. In connection with the latter, the correspondence between external and internal phases is being studied.

Cytological examinations were made on the following interspecific hybrids: *G. herbaceum* × *G. hirsutum*; (*G. herbaceum* × *G. Nanking*) × (*G. hirsutum* × *G. barbadense*—*i.e.*, representatives of all four sub-groups; *G. hirsutum* × *G. barbadense*—a valuable cross for the use in practice of the first generation hybrid; *G. barbadense* × *G. herbaceum*; *G. arboreum* × *G. barbadense*. These were all crosses which have proved to be of extreme interest at the Tashkent station.

G. peruvianum in the reduction division displayed many phenomena characteristic of a hybrid—auxiliary spindles, lagging chromosomes—and half the chromosomes coloured more strongly with hematoxylin than the other half. This question will be investigated further.

622. HYBRID COTTON PLANT: CYTOLOGY. By J. Szymanek. (*Compt. Rend.*, **194**, 1932, p. 1011. Abstr. from *Summ. of Curr. Lit.*, xii., **9**, 1932, p. 274.) Chromosome numbers obtained in cytological studies of *G. arboreum-sanguineum*, *G. vitifolium*, *G. punctatum*, and hybrids between the two latter and *G. herbaceum-indicum*, are given, and the practical utility of the hybrids is briefly discussed.

623. REVIEW OF LITERATURE ON THE GENETICS OF COTTON. By E. K. Emme. (In Russian.) (*Bull. Appl. Bot. Genet. and Plant-Breed.*, v., **26**, p. 129. Leningrad, 1931. From *Plant Breeding Abstracts*, 11, **4**, 1932, p. 196.) A rather complete bibliographical survey of cotton genetics in all countries.

FIBRE, YARN, SPINNING, WEAVING, ETC.

624. THE LANCASHIRE TEXTILE INDUSTRY. (John Worrall, Ltd., Oldham, 15s. post free; abroad, 17s. Abstr. from *Text. Rec.*, L., **590**, 1932, p. 80.) The forty-second annual edition of this invaluable book, which contains fully indexed and classified particulars of all cotton, wool, silk and rayon spinners, manufacturers, bleachers, dyers, finishers, and all other branches of the industry using power. The 1932 edition, which has been completely revised, contains two new features. The first is the special article on p. 27, which gives a retrospective view of conditions in the industry since the last issue was published, and second is the special supplement on p. 77, dealing principally with the new machinery, accessories, improvements, etc., recently introduced by many of the firms represented in the advertisement columns. There is, in addition, a list of cotton fabrics, and the firms engaged in their manufacture, as well as alphabetical lists of mill managers, secretaries, and salesmen.

625. FIBRE SECTIONS: PREPARATION. By J. Kisser. (*Faserforschung*, **9**, 1932, p. 239. Abstr. from *Summ. of Curr. Lit.*, xii., **9**, 1932, p. 270.) The preparation of sections and the various imbedding materials available are discussed. Imbedding in paraffin is satisfactory for most general studies of fibres. For the preparation of very thin sections for the study of the fine structure and also for the preparations of sections of yarns and fabrics, imbedding in celloidin-paraffin is recommended.

626. STAPLE FIBRE-CUTTING APPARATUS. By J. L. Rushton and W. Hartley. (Bolton. E.P. 367,835 of 24/11/1930. Abstr. from *Summ. of Curr. Lit.*, xii., **12**, 1932, p. 336.) Apparatus for producing staple fibre from threads or filaments is described, in which the thread is continuously fed in the direction of its length, and the end is cut whilst under the action of centrifugal force.

627. FUNDAMENTAL TEXTILE RESEARCH AND THE MICROSCOPE. By E. R. Schwarz. (*Amer. Dyes Rept.*, **21**, 1932, p. 59. Abstr. from *J. of Text. Inst.*, xxiii., **5**, 1932, A282.) A general survey of textile microscopy and its development, with particular reference to the Rheinberg method of differential illumination, stereoscopic effects, the action of chemicals on textiles, the determination of fibre density, spinning quality and yarn structure, and the use of ultra-violet and polarized light.

628. TEXTILE MAGNIFIER. By C. Zeiss. (*Instr. World*, **4**, 1932, p. 181. Abstr. from *J. of Text Inst.*, xxiii., **5**, 1932, A281.) This comprises a metal sphere in the top of which is mounted a × 6 aplanatic magnifier giving a perfectly flat field, free from colour. The magnifier can be focussed by means of a helical screw mount. The inside of the sphere has a reflecting surface which serves to concentrate the light from an opal bulb lamp on to the surface under examination. This illumination is intense, homogeneous, and practically shadowless, so that the magnifier is available for examining very coarse materials as well as those of exceedingly fine texture. If a filament lamp with clear bulb is used in place of the opal bulb, light can be thrown on to the material in different directions by simply rotating the lamp fitting in its housing. In this way greater detail can be detected in fine structure than with the ordinary shadowless illumination. [*Cf.* Abstr. **610**).

629. TEXTILES: TESTING. Federal Specifications Board, U.S.A. (*Text. World*, **81**, 1932. Abstr. from *Jour. of Text. Inst.*, xxiii., **6**, 1932, A335.) Gives the proposed standard methods for Government purposes for determining moisture content, " wool " content, total size and filling, breaking load by the grab and by the strip methods, fastness to laundering. In cases of disputes, physical tests are to be done on material conditioned at 65 per cent. RH and 70° F.

630. TEXTILE TESTING APPARATUS. By A. Viramont. (*Revue Text.*, **30**, 1932. Abstr. from *Jour. of Text. Inst.*, xxiii., **6**, 1932, A333.) A review of apparatus for measuring the strength and elasticity of textile fibres.

631. THE TESTING OF TEXTILES—WITH SPECIAL REFERENCE TO THE INVESTIGATION OF DEFECTS IN YARNS AND FABRICS. By W. E. King. (Abstr. from

Jour. of Text. Inst., xxiii., **6**, 1932, p. 102.) The subject is dealt with under the following heads: Types of testing; Necessity for textile investigator; Public and private testing authorities; Settlement of disputes; Testing of textiles; Methods of testing; Investigations of defects in fabrics.

632. Textile Fabrics: Durability. (1) Serivalor Laboratory. (*Textilberichte*, **13**, 1932, p. 188.) (2) By A. Rosenzweig. (*Text. World*, **81**, 1932, p. 1686. Abstr. from *Summ. of Curr. Lit.*, xii., **10**, 1932, p. 299.) (1) It is argued that breaking length is an erroneous conception which bears no relationship to actual strength, and that actual strength has no significance in relation to durability. Some results obtained with a "Tritometer" are recorded and discussed, but no description is given of the apparatus. The test consists in determining the time taken to wear a hole of constant size in a test piece by rubbing it with a constant rough surface, the pressure and speed of rubbing being capable of regulation. The relative quality of the common fibres is given as: rayon 0·03, silk 0·16, wool 1, linen 1·9, cotton 4·3. The absolute durability of fabrics of square weave and 100 g./sq. m. weight, expressed in days, each day representing sixteen hours' wear by a civilian, is given, for the present optimum in each class, as: rayon 11, silk 50, wool 300, linen 560, cotton 1,300. The optimum is the highest value obtained with the tritometer in tests of a large number of cloths of the same weight selected as the most frequently occurring weight from the best cloths of past years.

(2) Rosenzweig, of the Serivalor Laboratory, covers the same ground, but gives illustrations of wear testers.

633. Cotton: Nitration. By O. Ansel and S. S. Wong. (*Chem. Abs.*, **26**, 1932, p. 1436. Abstr. from *Summ. of Curr. Lit.*, xii., **10**, 1932, p. 286.) Nitration of various cottons gave different yields of nitrocellulose depending upon the cotton used. The average yields were: pure cotton linters 165·4, Ningpo cotton 155·6, Cantonese cotton 149·0, and purified cotton rags 145·4 per cent. The data show that it is more economical to use the cheaper grades of cotton for the preparation of nitrocellulose.

634. pH Control and its Applications. By C. E. Mullin. (Abstr. from *Text. Rec.*, vol. l., Nos. 591 and 592, 1932, pp. 63 and 53.) An explanation of the meaning of hydrogen ion concentration control, and a few of its applications in the textile industry.

635. The Oxidation by Gaseous Oxygen of Cotton impregnated with Sodium Hydroxide Solution. By G. F. Davidson. (*J. of Text. Inst.*, xxiii., **6**, 1932, T95.)

636. Rapid Methods of detecting "Damage" in Cotton and Wool. By A. J. Hall. (*Amer. Dyes Rept.*, **21**, 1932. Abstr. from *Jour. of Text. Inst.*, xxiii. **6**, 1932, A333.) Injury to cotton fibres may be detected by means of the swelling test (Fleming and Thaysen) and by the Congo Red test (Bright.)

637. Textile Materials: Waterproofing. By W. W. Triggs, London. (Resinous Products and Chemical Co., Philadelphia, U.S.A. E.P. 365,038 of 1/10/1930. Abstr. from *Jour. of Text. Inst.*, xxiii., **6**, 1932, A328.) The heavy metal salts of organic keto-acids derived from petroleum and polybasic acid anhydrides are soluble in toluene, hot turpentine, and drying oils, and may be used as waterproofing agents for textiles.

638. Textiles: Waterproofing. By D. M. Martin. (*Amer. Dyes. Rep.*, **21**, 1932. Abstr. from *Jour. of Text. Inst.*, xxiii., **6**, 1932, A325.) A report of a discussion of the development and present-day methods of waterproofing textile materials. Several references are made to experiments with rubber latex.

639. Cotton: Bleaching and Dyeing. By R. Levé. (*TIBA*, **10**, 1932, pp. 21 and 121. Abstr. from *J. of Text. Inst.*, xxiii., **5**, 1932, A267.) Methods of bleaching and dyeing cotton in the form of raw cotton, card slivers, hanks, bobbins, spools, warps and cloth are reviewed, and the advantages and disadvantages of treatment at the different stages are discussed.

640. New Uses for Cotton. (Abstr. from *Text. Weekly*, ix., **231**, 1932, p. 525.) Dust bags for vacuum cleaners, cotton filling for mattresses, insulating material using cotton, are among the new uses suggested.

641. A New Use for Cotton. (*Text. Rec.*, vol. L, No. 591, 1932, p. 87.) Another new use for cotton is reported by the Cotton Textile Institute following prolonged experiments by R. J. Colvin, of Buffalo, New York, in perfecting a moisture-proof, fabric-surfaced wood veneer adaptable for bridge table tops and various other pieces of furniture. The cotton fabrics, after being dusted with powdered crucible resin, are applied to the wood veneer in a special press 60 feet long under a high temperature pressure of more than 300 lb per square inch. The resin, melted on the surface of the gaily printed cotton materials, is colourless, and forms a protecting coating that is permanently impervious to water or other liquids. This novel material is also practical for soda fountain tops, restaurant booth furniture, as well as wall panellings.

642. Report of the Departmental Committee on Dust in Card Rooms in the Cotton Industry. (H M. Stat Off. Price 1s. 6d. net. Abstr. from *Int. Cott. Bull.*, x., **39**, 1932, p. 434) An exhaustive report dealing with health conditions in the card rooms of English cotton mills, and the susceptibility of the operatives to respiratory diseases due to their constant inhaling of dust whilst following their occupations. A number of recommendations were made by the Committee, which included: The adoption of improved means of extracting dust in raw cotton, the provision of respirators, institution of a medical examination, further exploration of the new avenue of research opened up by the discovery of histamine in cotton dust, introduction of artificial humidity into the air of the card room, the use of all-metal card clothing, the extended use of the Crighton opener, etc.

643. Cotton Gyrator Lummus Cotton Gin Co. (*Text. World*, **81**, 1932. Abstr. from *Summ of Curr. Lit.*, xii., **9**, 1932, p. 260.) The new Gyrator combines the opening, cleaning, mixing, and conveying of raw cotton, employing what is called the "gyrator" principle of cleaning cotton. It can be equipped with suitable bottom openings and used as a distributor over the hoppers of several lines of scutchers, or an inclined section of the machine can be used to elevate and convey the raw stock so as to replace the lattice apron, condenser, and fan. The machine itself consists primarily of three connecting rods which are supported and driven by crank shafts with crank pins 120 degrees apart and revolving in a long rectangular housing. Attached to each connecting rod is a series of staggered spring-steel fingers which propel the stock over a long section of grid bars. These fingers have a gyratory movement which causes them to penetrate the cotton as they move downward and forward, thus throwing the cotton against and along the grids a few inches at every stroke. This continuous whipping action opens the cotton, but is said not to cause curling, twisting, or stringing of the fibres regardless of the length of the machine. Trash drops through the grid bars as the stock passes through the machine, and as there are said to be no air currents in the Gyrator, the light trash is not held in suspension with the cotton. The capacity of the machine for maximum efficiency is between 1,500 and 1,800 lb. of cotton per hour. Power consumption is small, being a maximum of one-half horse power for each 10 ft section of the Gyrator. The maximum speed of the machine is about 150 strokes per minute, but slower speeds make possible a more thorough cleaning of the stock.

644. HIGHLY COMPRESSED COTTON: OPENING. Textile Operating Executives of Georgia. (*Cotton, U.S.A.*, 96, 4, 1932, p. 38. Abstr. from *Summ. of Curr. Lit.*, xii., 12, 1932, p. 337.) High density cotton is difficult to handle. In some mills the bales are allowed to expand for at least twenty-four hours after the ties are removed before the cotton is fed to the machines. In other mills it is considered that the cotton does not expand satisfactorily when left in this way, and it is found that high density cotton must be put through a preliminary opening before being fed on to the regular lattice opener. It is suggested that mills should refuse to accept high density cotton.

645. COTTON OPENING AND CARDING MACHINES: IMPROVEMENTS. By K. W. Mühlen. (*Spinn. u. Web.*, 50, Nos. 8 and 9, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., 9, 1932, p. 260.) Various Continental improvements in the construction and setting of cotton opening and carding machines are reviewed, and the most suitable speeds are indicated.

646. COTTON MILLS: MODERNIZATION. By C. L. Emerson. (*Cotton, U.S.A.*, 96, 1932, p. 44. Abstr. from *Summ. of Curr. Lit.*, xii., 8, 1932, p. 255.) The scrapping of obsolete textile machinery is recommended. A reduction of capacity in this way would be a cure for over-production and would reduce maintenance costs and permit better arrangement of the remaining machinery in individual mills. A scheme is suggested for the inspection of cotton mill equipment, and an agreement on the part of the mills to scrap parts of their equipment according to the results of the inspection. The machinery would be judged according to date of manufacture, amount of operation it had sustained, and present condition. It is considered that the adoption of the scheme would tend to stabilize prices and guarantee profit.

647. ELECTRIFICATION IN THE TEXTILE INDUSTRY. (*Sci. Abs.*, B35, 1932, p. 125. Abstr. from *Jour. of Text. Inst.*, xxiii., 6, 1932, A341.) Modern practice is described in the electric driving of textile mill machinery—preparation, spinning, and weaving machinery. The requirements of certain drives are given in detail. Descriptions of the usual drives adopted for the various kinds of machines are given, with typical figures of the motor sizes commonly used. The drive requirements of spinning machinery for yarns other than cotton do not differ materially, with the exception of artificial silk, which is considered separately. The difficulties of loom operation and the different drives adopted to meet weaving conditions economically are briefly explained.

648. CASABLANCAS HIGH DRAFT SYSTEM: APPLICATION IN MULE SPINNING. (*Text. Mfr.*, 58, 1932, p. 102. Abstr. from *Jour. of Text. Inst.*, xxiii., 6, 1932, A308.) The Casablancas tape system is claimed to be the most suitable for mule spinning. The advantages gained from its application are discussed, and a table is given showing the economies effected by conversion to high-draft spinning. A saving of 7d. per lb. of yarn spun is possible without decrease in quality of the product.

649. APPLICATION OF DIFFERENT SYSTEMS OF HIGH DRAFT SPINNING TO MIXINGS OF INDIAN COTTONS. By R. P. Richardson and N. Ahmad. (*Tech. Bull.*, Ser. A, No. 19, *Ind. Cent. Cott Comm.*, 1932.) Describes the results of tests carried out on mixings of two Indian cottons, Cambodia Co. 1 (295) and C. P. (Wun), using three different systems of high draft spinning and the ordinary system. A short description of the mechanical construction of each system is given.

The following are the main conclusions drawn from the experiments:

(1) Within the range of cottons and machinery used in the experiments, twist as an aid for reducing yarn breakages in the ring frame is most effective when short-staple cottons are spun on the ordinary system, and least so when comparatively long-staple cottons are spun on any of the three high draft systems.

(2) There is a large decrease in the number of yarn breakages as the quality of mixing improves. This shows one of the advantages of using a mixing of good quality, as with fewer breakages the number of ring piecers required to look after the frames would be correspondingly less.

(3) There is no apparent relationship between count and number of neps per yard-length of yarn, nor does the mode of spinning make any appreciable difference to the latter.

(4) Almost invariably yarns spun on the high draft systems are more even than those spun on the ordinary system.

(5) In every case the three high draft systems have given stronger yarns than the ordinary system. This suggests two economically advantageous ways of employing a high draft system: (i.) using mixings of an inferior quality, but obtaining yarns of the same quality as with the ordinary system; (ii.) using mixings of the same quality, but obtaining yarns of superior quality.

[*Cf.* Abstr. **512.**]

650. AUTOMATIC LOOMS: LUBRICATION. By J. Beh. (*Rev. Fil. et Tiss.*, **17**, 1932, pp. 26 and 91. Abstr. from *J. of Text. Inst.*, xxiii., **5**, 1932, A256.) The selection of materials, apparatus, and personnel for the lubrication of automatic looms is discussed, and a suitable programme is given.

651. AUTOMATIC LOOMS: EFFICIENCY. By W. A. Hanton. (*Text. Weekly*, **9**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **11**, 1932, p. 315.) A detailed criticism is offered of the report on the weaving experiments of the Lancashire Cotton Corporation under the following heads: (1) *Costings.*—Some errors are pointed out. The automatic looms have not been run under the most economical conditions, and the costs are probably high compared with the plain looms. The labour required is discussed. (2) *The Behaviour of the Looms.*—Automatic looms give a cloth of slightly better quality than Lancashire looms. The relative merits of the various looms with reference to let-off motions, constancy of cloth particulars, waste, and the changing of " sorts " are discussed, and the necessity for careful preparation of the warps is pointed out. (3) *Conclusions.*—The " more-looms-per-weaver " system is dealt with, and estimates are made of the time spent by the weaver on various operations.

652. TOYODA LOOM SHUTTLE CHANGING MECHANISM. Platt Bros. and Co., Ltd. (Oldham), and K. Toyoda (Nagoya, Japan). (E.P. 369,970 of 24/12/30. Abstr. from *Summ. of Curr. Lit.*, xii., **10**, 1932, p. 294.) Details are given of improved shuttle-changing mechanism for automatic looms, of the kind in which shuttles are pushed from a magazine into a shuttle box, and are made to push other shuttles out of the box.

653. MORE LOOMS SYSTEM: COSTS. By H. Richter. (*Kunstseide*, **14**, 1932, p. 124. Abstr. from *Summ. of Curr. Lit.*, xii., **10**, 1932, p. 311.) It is pointed out that in determinations of the savings effected by increasing the number of looms per weaver, the influence of the fixed costs is frequently overlooked. The relation of fixed costs to wages is discussed, and the factors limiting the increase in the number of looms per weaver are outlined. An equation is deduced for the reduction in total cost of production for an increase in the number of looms per weaver. An example is worked out. The loom efficiency is an important factor in such calculations.

654. Gawsworth Loom. By O. Shimwell. (E.P. 369,694 of 16/1/1931. Abstr. from *Summ. of Curr. Lit.*, xii., **10**, 1932, p. 294.) In looms of the type in which the weft threads are drawn into the warp in loop form from opposite sides of the loom by weft carriers, each complete loop of weft drawn out at one side of the warp serves for one weft thread when drawn into the warp, but two successive complete loops (at one side of the warp), which form two weft threads in the warp, form also a loop in the fabric with the closed end in the cloth selvedge at one side of the cloth, and the two free ends at the other selvedge, one free end being within a loop formed by a pair of weft threads drawn into the cloth from the other side, and the other between two such loops. The invention further comprises drawing the weft threads into loops adjacent to and alongside opposite sides of the sheet of warp threads, gripping the ends of the loop, releasing one end and carrying the looped weft thread into the warp at a point adjacent to the means for gripping the ends of the loop. The patent includes improved means for the production of the loops of weft and for controlling the loops and their ends during transference into the warp.

655. Warp Tensioning Device. By R. Cotton (Haslingden). (E.P. 371,083 of 13/2/1931. Abstr. from *Summ. of Curr. Lit.*, xii., **11**, 1932, p. 317.) In order to obtain the ideal timing' conditions of the picking, shedding, and slay movements of a loom, to ensure the production of plain cloth having a good cover, and to facilitate the insertion of the weft in heavily picked cloths, an oscillating lease rod or control bar which is lifted for one beat-up and lowered for the next beat-up to vary the tension on the alternate lines of warp is given a dwell in its central position equal to and coincident with the dwell of the healds when the shed is open. The oscillating lease rod is operated by a cam geared to revolve once for every two beats up of the slay, and provided with concentric portions which will allow the lease rod to rest or dwell in its central position at two points in each revolution.

656. Shuttleless Loom Weft Tensioning Device. Gledhill Weaving Machine Co., Ltd. (Huddersfield), and W. Gledhill. (E.P. 371,155 of 9/4/31. Abstr. from *Summ. of Curr. Lit.*, xii., **11**, 1932, p. 317.) In looms employing stationary weft supplies, of the type in which the weft is gripped at one side of the loom and carried part way across the shed by one horizontally moving member and is there taken possession of by a second horizontally moving gripper which completes the laying of the pick, the weft is passed between the weft-inserting member and the source of weft supply, through a tension member rotatable about an axis, and having two engaging points offset at diametrically opposite points from the axis, the tension member engaging the weft and being connected with operating means whereby it is turned in one direction as the lay approaches front centre, to cause one engaging point to tension the weft, and in the opposite direction as the lay approaches back centre, to cause the other engaging point to tension the weft.

657. Weaving Shed: Management. (*Text. World*, **81**, 1932, p. 1096. Abstr. from *Jour. of Text. Inst.*, xxiii., **6**, 1932, A314.) The writer discusses the conditions in a cotton mill in which the efficiency is maintained a little higher than the average by careful attention to details rather than by any particular settings of loom mechanisms. Brakes are checked and adjusted regularly, and at stopping time the weavers stop the looms by the fingers of the warp stop motion instead of using the shipper handles. Belts are kept tight and are cleaned weekly and shuttles are examined regularly. The friction is set a little closer, and the pick a bit early, and the looms have been speeded up.

658. **Weaving Shed Noise: Prevention.** By H. Schlomer. (*Textilberichte*, 13, 1932. Abstr. from *Jour. of Text. Inst.*, xxiii., 6, 1932, A314.) The author discusses the systematic investigation and prevention of noise in weaving sheds, giving an analysis of various causes.

LEGISLATION.

659. **Australia.** *Cotton Industries Bounty Act*, 1930. *Statutory Rules*, 1932, *No.* 49 *of May* 18, 1932, provide for the examination of claimants, etc., on oath.

660. *Cotton Industries Bounty Act*, 1932, dated May 28, 1932, amends the Act of 1930 in regard to the total amount of bounty, specification of bounties, and rates of bounty.

661. **Nigeria.** *Regulations* (No. 2 of January 11, 1932) amend Regulations 11, 15, 19 and 25 of the Cotton Export Regulations, 1926 (No. 37 of 1926).

662. **Tanganyika Territory.** *The Cotton Rules*, 1931. *Government Notice No.* 84 (April 23, 1931), deals with the following: Seed for distribution; cotton cultivation; sale and purchase of cotton; ginneries; penalties.

Cotton (*Fees*) *Rules*, 1931. *Government Notice No.* 85 (April 23, 1931) states the fees payable for the year ended March 31, 1932. *Government Notice No.* 718 (April 23, 1931) states the conditions necessary to the issue of ginnery licences.

TRADE, CO-OPERATION, ETC.

663. **Remedies for the Crisis in the Cotton Industry.** By R. Brasseur. (*Int. Cott. Bull.*, x., 39, 1932, p. 310.) Deals with the following: Financial remedies, development of consumption, restriction of production, protectionism.

664. **Currency Systems and Trade Restrictions in Connection with the World's Cotton Industry.** By G. Mylius. (*Int. Cott. Bull.*, x., 39, 1932, p. 332.)

665. **The Repercussions of Currency Fluctuations and Trade Restrictions upon the Future of the World's Cotton Industry.** By R. A. de la Baumelle. (*Int. Cott. Bull.*, x., 39, 1932, p. 326.)

666. **Cotton Goods: Excess Output Problem.** (*Times Trade and Eng. Supplt.*, May 21, 1932.) Discusses the subject of colonial and foreign competition.

667. **Market Trend of World Textile Trade.** By A. Niemeyer. (*Text. Rec.*, l., 590, 1932, p. 23.) A very readable article showing the trend of the textile market in Great Britain, France, Italy, Switzerland, Austria, Czecho-Slovakia, Poland, United States, Japan, India, Australia.

668. **Raw Cotton: Consumption and Stocks.** By J. A. Todd. (*M/c. Guar. Coml.*, 24, 1932, p. 205.) An analysis is presented of the International Federation's figures for the last half-year, corrections being applied for the various bale weight units. The corrected figures show that the ratio of non-American to American cotton reached a peak of consumption of 94·5 per cent. in the early part of 1930, but has now fallen to 80·2 per cent. This recovery of American cotton is partly due to the excellence of the 1931 crop, but the last half-year's consumption of 2,970 million lb. is still far below the 3,539 million lb. for the half-year preceding the financial crash in the U.S.A.

669. **Lancashire or Japan?** By C. E. Lane. (*Crown Colonist*, June, 1932, p. 301.) A challenging article dealing with British manufacturers' shortcomings in regard to the export trade, in which the author is careful to quote chapter and verse, and to supply actual figures in support of every statement he makes.

670. COTTON HOURS AND WAGES. (*Text. Rec.*, l., 590, 1932, p. 21.) Points out the necessity of reducing the costs of production in the cotton industry, and suggests the adoption, under certain conditions, of the more-looms-per-weaver system.

MISCELLANEOUS.

671. THE HERITAGE OF COTTON: THE FIBRE OF TWO WORLDS AND MANY AGES. By M. D. C. Crawford. (G. P. Putnam's Sons, New York and London, 1931. Price 21s. From *Plant Breeding Abstracts*, 11, 4, 1932, p. 217.) An account of the development of the use of cotton through the ages, in non-technical language and with ample illustrations. Indications are given of how research in technology has added to progress.

672. SCIENCE OF THE YEAR 1931: THE BIOLOGICAL SCIENCES. By W. B. Brierley. (Reprint recd. from Dpt. of Mycology, Rothamsted Exp. Sta., 1932.) The usual readable account of the general progress of biological science during the year, given under the heads of Evolution and Genetics; Zoology; General Physiology; Botany; Microbiology and Disease.

673. THE INTERNATIONAL INSTITUTE OF AGRICULTURE: AN HISTORICAL AND CRITICAL ANALYSIS OF ITS ORGANIZATION, ACTIVITIES AND POLICIES OF ADMINISTRATION. By Asher Hobson, M.A. (Univ. Calif. Press, Berkeley, California, 1931. Thèse de doctoral et sciences politiques. Univ. de Genève, No. 6.) The Institute owes its inception to David Lubin, a (Polish) Californian, who ultimately enlisted the sympathy and support of the King of Italy—the reason why it is located in Rome. The book is a carefully thought out and reasoned discussion of the organization and management of the place. The author sets out his reasons for the failure of the Institute, in his opinion, to become in any—even approximate—manner the impartial authority of statistical and other reference for the agriculturist that its founder intended it to be. Some of these causes are stated by him to be: the lack or suppression of scientific ability amongst the staff, too great a diplomatic representation upon the Permanent Committee, the want of sufficient directing authority by the head, too great a representation of one or two nations upon the staff, and general inability to execute properly even the existing programme, while continually seeking to extend it. The place is described as being altogether too amateurish: "its record inspires no confidence; its prestige is diminishing; its abilities are questioned, and it is facing a crisis." To those engaged in agricultural organization the book should prove an interesting study.

674. NORTH-WESTERN POLYTECHNIC. We have received a notice stating that evening courses in textiles—including theoretical and practical studies of the chief textiles from the retail standpoint, store management, and salesmanship—will be held at the Polytechnic on Tuesdays and Wednesdays, at 7.30 p.m., beginning September 27, 1932.

PERSONAL NOTES

We much regret to announce the death of Mr. James Crinion, which occurred on August 13 at his home, Union Street West, Oldham. Mr. Crinion had been a member of the Council of the Corporation since 1922.

STUDENTSHIPS.

The Studentships awarded last year to E. J. Butler, J. Marshall, E. J. M. Shearer, and N. M. Wight have been confirmed for a second year, and will be tenable at the Imperial College of Tropical Agriculture, Trinidad.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

Fiji	Mr. R. W. Paine.
Gold Coast	Mr. G. C. Coull.
Kenya Colony	Mr. F. B. Butler.
,,	Mr. W. D. D. Jardine.
,,	Mr. C. D. Knight.
,,	Mr. W. G. Leckie.
,,	Mr. R. H. Le Pelley.
,,	Mr. A. C. Maher.
,,	Mr. H. Wolfe.
Nigeria	Mr. G. Bryce.
,,	Mr. E. T. Holmes.
,,	Mr. I. E. James.
,,	Mr. B. G. Owen.
,,	Mr. J. W. R. Pedder.
,,	Mr. S. D. Ross.
,,	Mr. A. F. W. Sheffield.
,,	Mr. J. V. R. Smyth.
Nyasaland	Mr. E. Lawrence.

Sierra Leone	Mr. M. Vardry.
Tanganyika	Mr. L. R. Doughty.
„	Mr. L. C. Edwards.
„	Mr. A. E. Haarer.
„	Mr. W. V. Harris.
„	Mr. W. B. Hutchinson.
„	Mr. F. R. Sanders.
„	Mr. E. T. Ward.
Uganda	Mr. C. E. J. Biggs.
„	Mr. C. W. L. Fishlock.
„	Mr. W. S. Martin.
„	Mr. G. W. Nye.
„	Mr. R. W. Stuckey.
West Indies (Leeward Is.)	Mr. H. B. Pidduck.
„ (Trinidad)	Mr. J. de Verteuil.

The following officers of the Corporation's staff abroad are on leave in this country:

South Africa	Mr. O. V. S. Heath.
„	Mr. D. Macdonald.
Sudan	Mr. T. Trought.

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